BARBER COLMAN

1211.8
IN 3-4

SERIES 273A
CAPACITROL

INSTRUCTION MANUAL

GENERAL ELECTRIC
INSTRUMENTATION & COMMUNICATION
1200 KONA DRIVE
COMPTON, CA 90220
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MP MASTER
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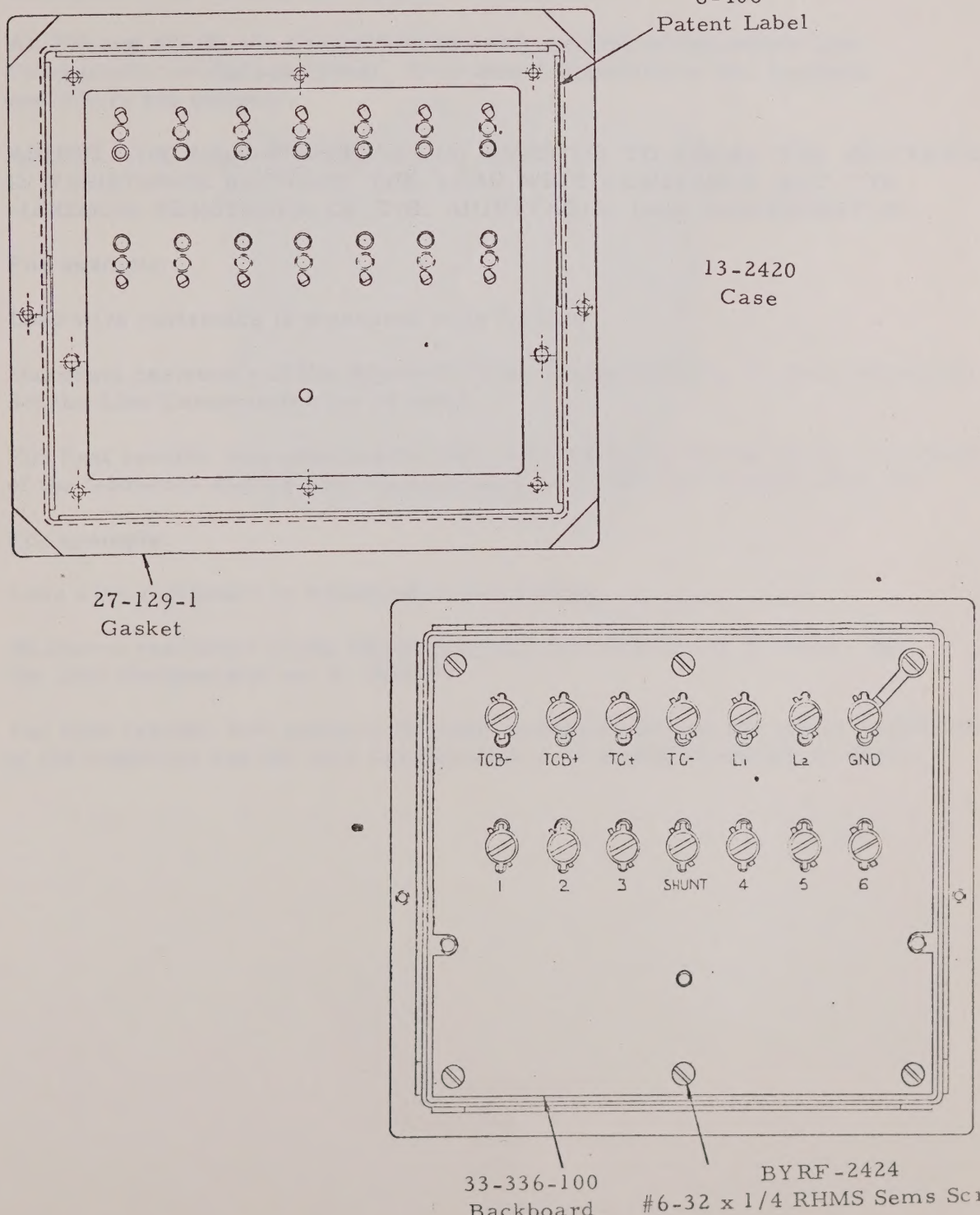
THE INSTRUCTIONS GIVEN HEREIN COVER THE DESCRIPTION, INSTALLATION, OPERATION AND MAINTENANCE OF SUBJECT EQUIPMENT. BARBER-COLMAN RESERVES THE RIGHT TO MAKE ENGINEERING REFINEMENTS THAT MAY NOT BE REFLECTED IN THIS BULLETIN.

March, 1973

ERRATUM TO 1211.8 IN 3-4

Figure 6-7 is not correct. The drawings below replaces it.



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January 1973

ERRATUM

TO ALL INSTRUCTION MANUALS OR INSTALLATION & WIRING MANUALS WITH THE FOLLOWING LITERATURE PREFIXES: 1211.6 (470 Series Controller) and 1211.8 (270 Series Controllers).

All 270 and 470 Series Controllers are shipped with an Adjustable Line Compensator on the rear panel. 0-15 ohm Compensators are standard, and others are optional.

ADJUST THE LINE COMPENSATING RESISTOR TO EQUAL THE DIFFERENCE IN RESISTANCE BETWEEN THE LEAD WIRE RESISTANCE AND THE MAXIMUM RESISTANCE OF THE ADJUSTABLE LINE COMPENSATOR.

For example:

Lead wire resistance is measured to be 5 ohms.

Maximum resistance of the Adjustable Line Compensator is 15 ohms (standard). Set the Line Compensator for 10 ohms.

For best results, now measure the total resistance across the series resistance of the leadwires and the Line Compensator -- it should be exactly 15 ohms.

For example:

Lead wire resistance is measured to be 17 ohms.

Maximum resistance of the Adjustable Line Compensator is 30 ohms. Set the Line Compensator for 13 ohms.

For best results, now measure the total resistance across the series resistance of the leadwires and the Line Compensator -- it should be exactly 30 ohms.

SECTION 1
DESCRIPTION

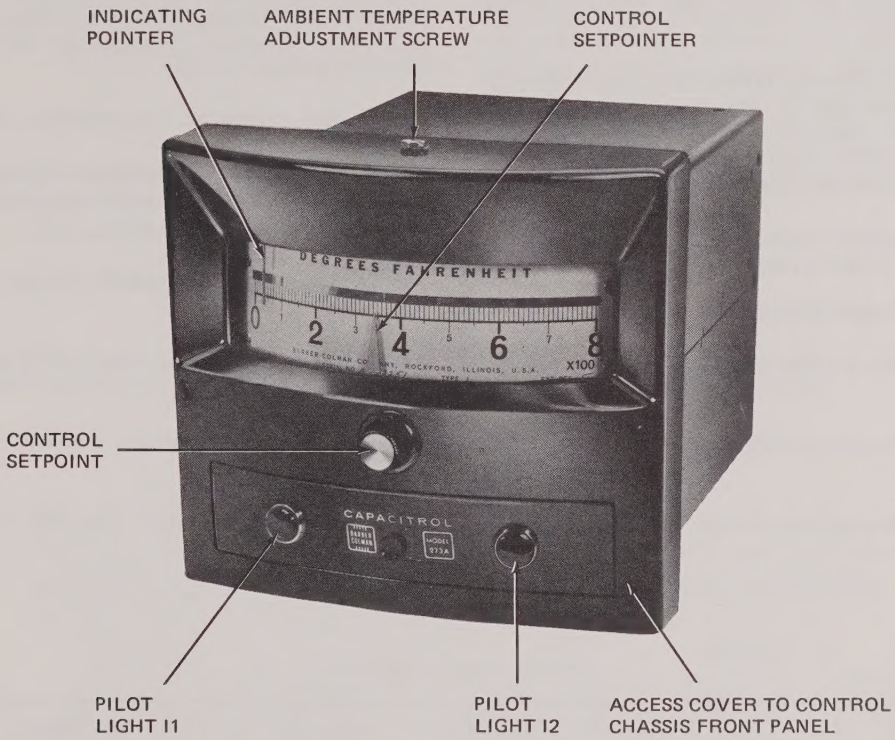


Figure 1-1. Series 273A

1.1 GENERAL

The Series 273 is an indicating millivoltmeter controller that provides separate on-off relay switching action for two different points on a temperature scale. One control point is usually a temperature control and the other control point is either for sounding an alarm, turning off an auxiliary heater, or turning on a cooling device.

The control setpoint is indicated by a vertical green pointer and it is set by adjusting the front panel knob. The other control point is a "phantom" setpoint without an indicator and it is adjusted by the spread control located behind the front panel door. The spread setpoint control determines the position of the "phantom" setpoint from 1/2 to 4% of full scale away from the control setpoint indicated by the green pointer. The "phantom" setpoint can be adjustable either above the indicated control setpoint or below it, depending upon the model number selected. Time proportioning of relay contacts is available on certain models to minimize overshoot and undershoot and provide better control action. Also located behind the front panel door is a manual reset control which allows the controller to be adjusted for any load offset.

This controller accepts either a millivolt source with a minimum span of 12 mVdc or the output of a standard Barber-Colman thermocouple. More than fifty standard scale ranges are available for the five inch scale, which has an anti-parallax mirror. Temperature indication is by the upper pointer of the meter. Since the thermocouple input is directly to the meter without any electronic amplification, the meter will indicate a process temperature during a complete power failure.

The Series 273 can actuate solenoid valves, medium sized electrical contactors, or relays, and motor controlled valves to control large temperatures. In addition, the Series 273 is applicable to directly controlling up to 1200 VA of power to small heating elements.

1.2 SPECIFICATIONS

Minimum Input Span 12 mVdc or 0-400°F, type J thermocouple.

Temperature Indication Red process variable pointer indicates temperature in degrees on a five inch temperature scale.

Control Setpoint Temperature Control setpoint temperature selected by adjusting a front panel knob to position a vertical green pointer until it coincides with the desired setpoint on the scale.

Spread (Phantom) Setpoint Temperature Spread setpoint temperature is selectable by adjusting a control located behind the front panel door. The amount of spread is adjustable from 1/2 to 4% of full scale away from the indicated Control Setpoint Temperature.

Cycle Time Adjustable from 3 to 30 seconds. Only on models with time proportioning.

Relay Switching Output Ratings

Resistive Load, two position control: 10A at 120 Vac, 5A at 240 Vac.

Resistive Load, time proportioning control: 5A at 120 Vac, 2.5A at 240 Vac.

Inductive Load, two position control: 5A at 120 Vac, 2.5A at 240 Vac.

Inductive Load, time proportioning control: 2.5A at 120 Vac, 1.25A at 240 Vac.

Reset Tamper proof internal front panel adjustment. Adjustable throughout the entire range of the instrument to eliminate offset at control point.

Proportioning Band 2% of full scale. Not Adjustable. Only on models with time proportioning.

Accuracy ±1% of full scale.

Multi-Voltage Capability 120 or 240 Vac.

External Resistance Compensator Adjustable Line Compensating Resistance Assembly (adjustable from 0 to 15 ohms) shipped set at 7.5 ohms.

Thermocouple Break Protection Heating off with open thermocouple.

Ambient Temperature Operating: +40°F to +130°F. Storing: −40°F to +150°F.

Sensitivity 90 microamperes nominal for full scale deflection.

Power Consumption 9VA at 120, 208, or 240 Vac, 50 or 60 Hz.

Table 1-1. Modes of Operation

Model Number	Control Set Pointer	Phantom Set Pointer	Time Proportioning
273A	Low point	High point	None
273A-1	Low point	High point	Low point
273A-2	Low point	High point	High point
273A-3	Low point	High point	Both points
273A-4	High point	Low point	None
273A-5	High point	Low point	Low point
273A-6	High point	Low point	High point
273A-7	High point	Low point	Both points

SECTION 2
INSTALLATION

2.1 UNPACKING

This instrument has been manufactured carefully, inspected, and packed at the factory. Check the contents of the shipping container against the packing slip. If the equipment is damaged in transit report the extent of the damage to the carrier immediately. Repack in the original box until ready for installation. Any instructions given on tags attached to the instrument should be followed carefully and then the tags should be removed. Handle with care.

2.2 MOUNTING

Refer to Figure 2-1. Locate the instrument to avoid shock, excessive vibration, dust or oil accumulations, and moisture. The ambient temperature should be within 40°F to 130°F. Avoid furnace walls and other sources of radiant heat.

After the instrument is installed, remove the rear terminal board cover plate (if supplied) and disconnect the jumper wire across terminals marked SHUNT and TC–. This wire is used to shunt or dampen the meter movement for protection during shipping, handling, and installing the instrument, but should be removed for operation. Replace the shunt wire when handling or shipping the instrument, and also position the green control setpoint pointer fully upscale.

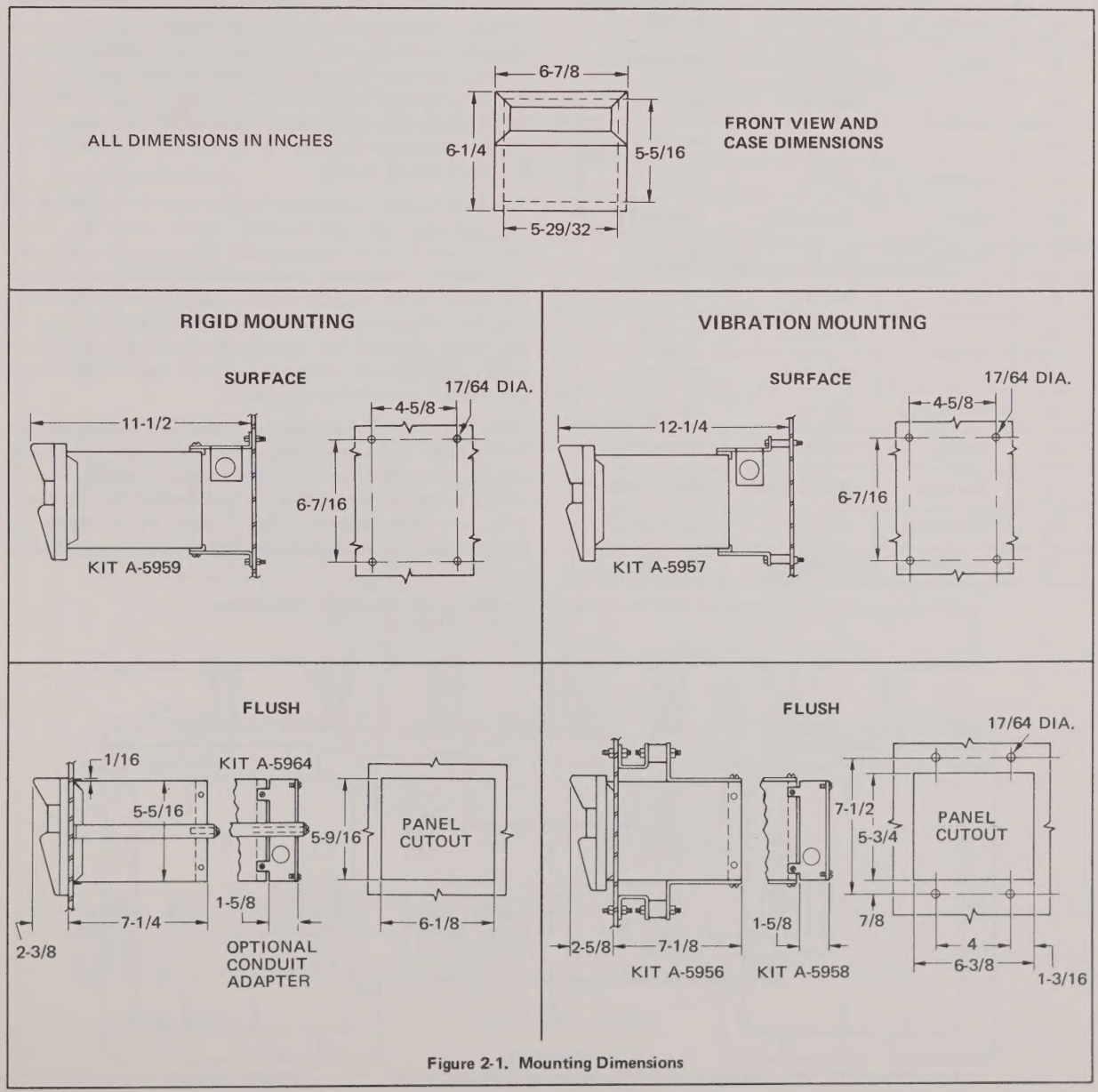


Figure 2-1. Mounting Dimensions

2.3 POWER WIRING

Normally, the instrument is shipped with the power wiring connected as specified on the order. A horizontal patchboard, located between relays K1 and K2, may be patched to provide either 120 Vac, 208 Vac, or 240 Vac. See Figure 2-2 and Table 2-1.

Refer to Figure 2-3. Input line voltage must be 120, 208 or 240 Vac ±10%, 50 or 60 Hz. The instrument should be supplied with power from the same source supplying the other instruments in the system. Instrument should be grounded – do not connect ground (G) terminal to the neutral a-c line. Maximum instrument protection can be obtained by installing a 1/8 ampere slow-blow fuse in the power supply to the instrument.

Table 2-1. Power Wiring Patching

Pin Code	T_1 & T_2 Primaries		
	120 Volt	208 Volt	240 Volt
A	Wht/Red T_1	Wht/Red T_2	Wht/Red T_2
B	Wht T_1	Wht/Red T_1	Wht/Red T_1
J_1	Jumper	Not Used	Not Used
J_2		Not Used	Not Used
C	Wht/Red T_2	Wht T_1	Wht T_1
D	Wht T_2	Grn/Red T_1	Blk/Red T_1
E	Blk/Red T_1	Blk T_2	Blk T_2
F	Blk T_1	Blk T_1	Blk T_1
J_3	Jumper	Not Used	Not Used
J4		Not Used	Not Used
G	Blk/Red T_2	Wht T_2	Wht T_2
H	Blk T_2	Grn/Red T_2	Blk/Red T_2
J_5	Not Used	Store Jumpers	Store Jumpers
S_1	Grn/Red T_2	Blk/Red T_2	Grn/Red T_2
S_2	Grn/Red T_1	Blk/Red T_1	Grn/Red T_1

2.4 INPUT WIRING

See Figure 2-3. Do not place power wiring and thermocouple wiring in the same conduit or wiring trough. The wires from several thermocouples may be in the same conduit or wiring trough. If shielded thermocouple leads are used, the shield should be insulated electrically and terminated at one location, preferably the chassis of the instrument. If possible, keep temperature gradients at a minimum at the thermocouple terminal strip by a cover or suitable insulating material such as Fiber-frax.

Thermocouples require special compensated leadwire. Be sure to use wire that matches thermocouple in use, and for which the instrument has been calibrated. Thermocouple type is noted on the scale. Ordinary copper wire can be used only with resistance elements and the newer exotic high temperature thermocouples. Check installation instructions for these sensors.

The Barber-Colman Thermocouple Catalog lists a complete selection of thermocouple assemblies and thermocouple extension leadwire. Wire only with thermocouple extension leadwire such as that specified in the Barber-Colman catalog. Observe the correct thermocouple and thermocouple extension wire polarity. The negative wire of both is usually coded red. Indicator pointer of the instrument should move upscale when a temporary junction of the extension wire is heated.

Standard model instruments require that the resistance of the thermocouple and leadwire should equal the "Ext. Res." marked on the scale (usually 15 ohms external to the instrument). Additional resistance can be accommodated on special orders and the amount will appear on the scale. The Line Compensating Resistance Assembly (located on the lower back of the rear panel) should be adjusted to equal the difference between the lead wire resistance and the resistance marked on the scale.

Units are shipped with external resistance compensation set at midpoint (7.5 ohms). The single unit meter and chassis plug-in assembly has a thermocouple selection feature which should be checked to see that thermocouple connections are made properly. This is done by removing the instrument from its case and noting the pin connections on

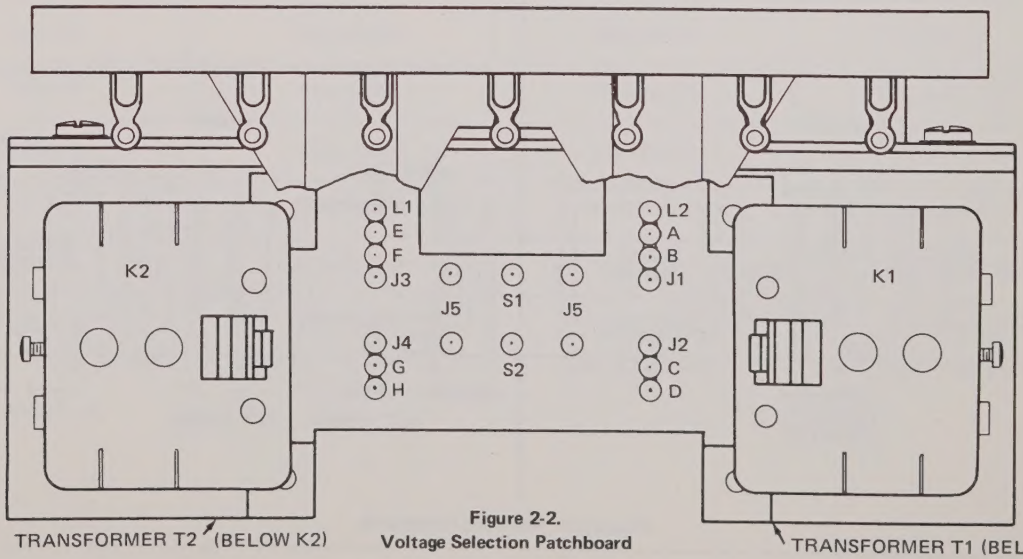


Figure 2-2.
Voltage Selection Patchboard

the small terminal board at the rear of the meter enclosure. The yellow leadwire should always be connected to pin "A" and the blue leadwire should always be connected to pin "B". If a base metal thermocouple is used (Type J, T, or K), the red-white leadwire should be connected to the third pin "C" or "D". If a noble metal thermocouple is used (Type R or S), the red-black wire should be connected to pin "C" or "D". This wiring information is also on the backboard and on Figures 6-3 and 6-4.

2.5 CONTROL WIRING

Terminals 1, 2, and 3 are the low point relay contacts.

Terminal 1 is the normally closed contact.

Terminal 2 is the common.

Terminal 3 is the normally open contact.

Terminals 4, 5, and 6 are the high point relay contacts.

Terminal 4 is the normally open contact.

Terminal 5 is the common.

Terminal 6 is the normally open contact.

The relay switching output ratings are as follows:

Resistive Load, two position control: 10A at 120 Vac, 5A at 240 Vac.

Resistive Load, time proportioning control: 5A at 120 Vac, 2.5A at 240 Vac.

Inductive Load, two position control: 5A at 120 Vac, 2.5A at 240 Vac.

Inductive Load, time proportioning control: 2.5A at 120 Vac, 1.25A at 240 Vac.

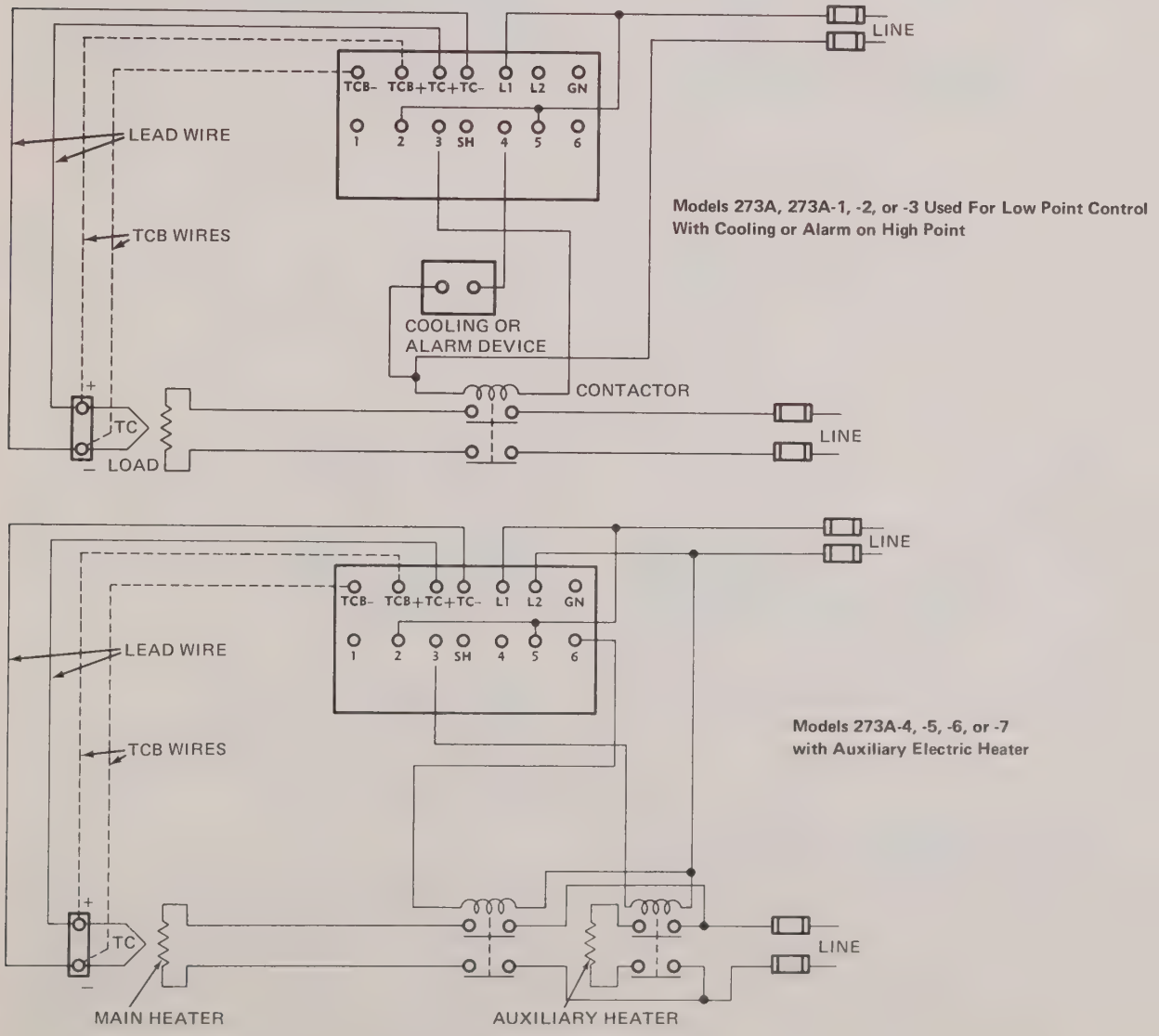


Figure 2-3. Typical External Wiring Diagrams

2.6 THERMOCOUPLE BREAK PROTECTION (TCB)

The Series 273 is equipped with thermocouple break protection which may be connected if desired. Copper wire, 16 to 20 gauge, is generally used. The best method is to make connections to the thermocouple connection head (Figure 2-4). Polarity must be observed carefully. If properly connected, a break in the thermocouple circuit will cause the indicator to drive to the right of the green pointer, causing the relay to drop out and assume its normal non-energized position.

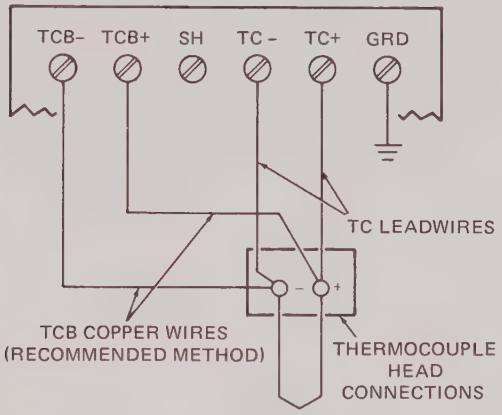


Figure 2-4. Method of Thermocouple Break Protection

2.7 INSTALLATION ADJUSTMENTS

2.7.1 Meter Alignment

The meter should read ambient temperature with the thermocouple and thermocouple break wiring disconnected. If it does not, adjust the Ambient Temperature Adjustment screw on top of the front cover. Figure 1-1 shows its location.

2.7.2 TCB Compensation

When TCB is connected a slight error may be introduced into the measuring system. With the instrument powered, and with the thermocouple maintained at a steady temperature, disconnect one of the TCB leadwires and see if there is any slight meter indicator movement. If there is, record the final scale position of the meter indicator and then reconnect the TCB lead. Next, adjust the Ambient Temperature Adjustment screw on the top of the meter housing until the meter indicator is at the same position it was when TCB was disconnected.

SECTION 3
OPERATION

3.1 GENERAL

This section provides complete operating instructions for the Series 273. Paragraphs 3.2 and 3.3 are provided to familiarize you with the controls. The remaining paragraphs tell how to obtain optimum control settings. Final control adjustments should be made after the unit is in operation 45 minutes.

3.2 STANDARD FRONT PANEL CONTROLS AND INDICATORS

See Figure 1-1.

CONTROL SETPOINT KNOB – The control setpoint temperature or millivoltage is determined by the position of the CONTROL SETPOINT KNOB and indicated by the vertical green pointer on the scale.

INDICATING POINTER – Vertical red pointer that indicates process temperature or millivoltage input even with power off.

PILOT LIGHTS 11 AND 12 – Indicates control action (Figure 3-3).

3.3 CONTROL CHASSIS FRONT PANEL CONTROLS

The control chassis front panel controls (Figures 3-1 and 3-2) are accessible by removing the access cover. The access cover is removed by pulling the small knob located below the control setpoint knob.

RESET CAPACITOR C7 – Provides a means of aligning the red meter temperature pointer with the green setpoint pointer to correct for offset. The RESET control C7 is capable of resetting through the entire range of the instrument for any load offset.

SPREAD POTENTIOMETER R22 – Determines the position of the SPREAD setpoint with respect to the CONTROL SETPOINT. When the SPREAD potentiometer R22 is fully counterclockwise, the spread setpoint is 1/2% of full scale away from the control setpoint. When the SPREAD potentiometer R22 is fully clockwise, the spread setpoint is 4% of full scale (possible greater depending upon circuit variations) away from the control setpoint.

CYCLE TIME POTENTIOMETER R44 — Models 273A-1, -2, -3, -4, -5, -6, and -7. Single turn potentiometer for selecting a cycle time ranging from 3 seconds when fully counterclockwise to more than 30 seconds when fully clockwise. When adjusting cycling time on -3 and -7 models, it is necessary to readjust the RESET capacitor C7 to maintain circuit operating conditions.

3.4 RESET ACTION ADJUSTMENT

Turning the RESET control counterclockwise will shift the meter indicator to the left. With a small screwdriver, turn the RESET control C7 to the midpoint of its range. If the red temperature pointer does not coincide with the green setpoint pointer after the controlled load becomes thermally stable, an adjustment should be made. For models with time proportioning control, turn the CYCLE TIME control fully counterclockwise to its minimum cycle time. An adjustment is then made with the RESET control C7, turning it in small increments with sufficient time allowed after each adjustment to permit the controlled load to become thermally stable. The proper reset adjustment occurs when the red meter temperature pointer coincides with the green setpoint pointer when the load is thermally stable.

3.5 CYCLE TIME ADJUSTMENT

Models with time proportional control are provided with a Cycle Time adjustment for varying the relay switching rate from 3 (at CCW) to more than 30 (at CW) seconds per cycle. The faster cycle rates provide better control of loads with fast response times and little lag time.

However, a relatively faster cycle time causes added wear on the chassis relays and any external contactors.

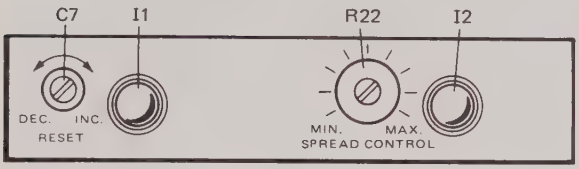


Figure 3-1.
Control Chassis Front Panel Models 273A and 273A-4

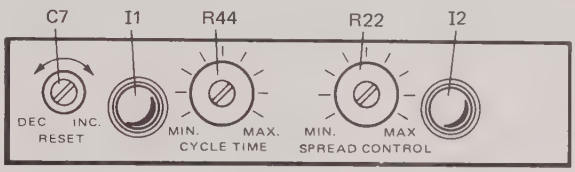


Figure 3-2.
Control Chassis Front Panel Models 273A-1, -2, -3, -5, -6 and -7

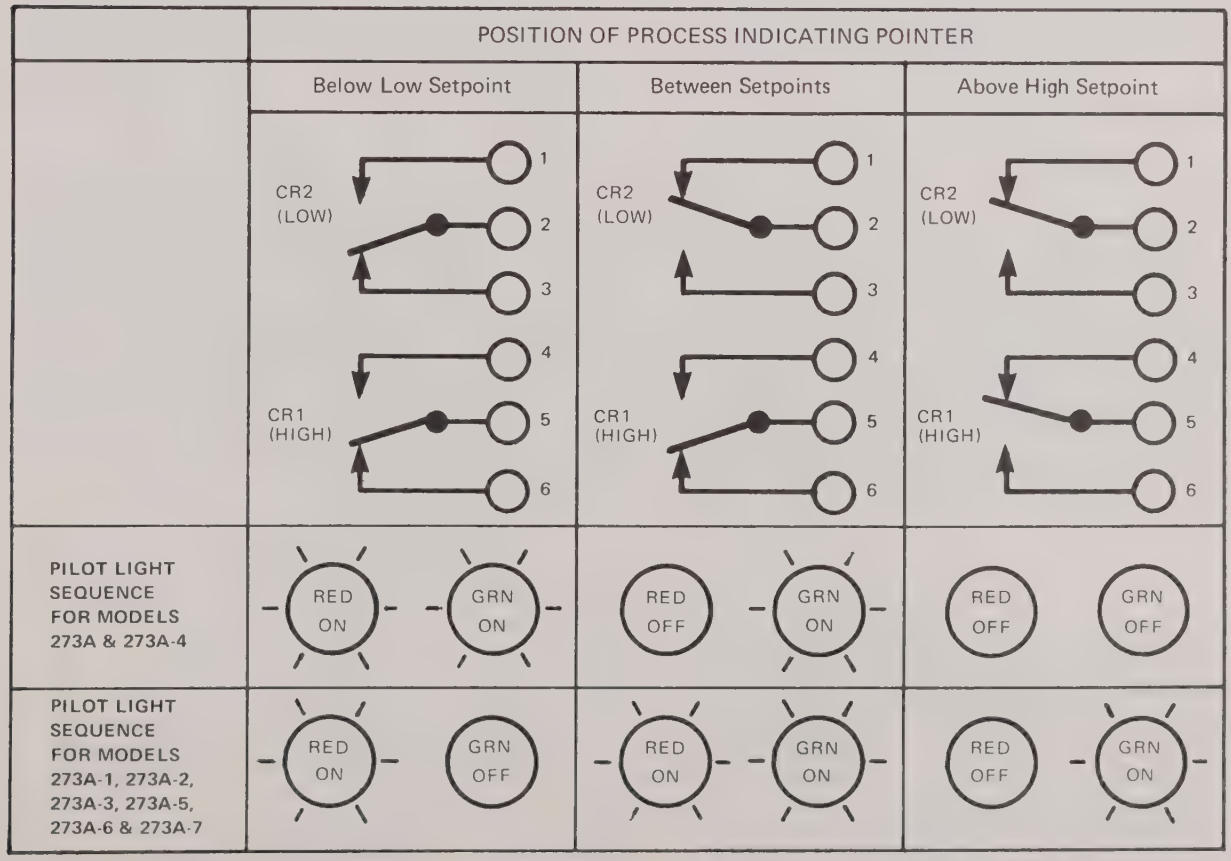


Figure 3-3. Pilot Light Indication and Control Relay Action for the Position of the Process Indicating Pointer

SECTION 4
CIRCUIT DESCRIPTION

4.1 GENERAL

Refer to Figures 6-3 and 6-4, which are overall schematics. Most of the electrical components shown on either Figure 6-3 or 6-4 are on the printed circuit board (either Figure 6-1 or 6-2). The exceptions are the components listed in Table 6-2. All the components listed in Table 6-2 are called out on either Replaceable Parts Figures 6-8, 6-9, 6-10, or 6-11.

4.2 CONNECTIONS

4.2.1 Thermocouple

Refer to the left side of Figures 6-3 and 6-4. The incoming signal from the thermocouple on the rear panel terminals marked TC+ and TC– goes without amplification to drive the meter.

4.2.2 TCB (Thermocouple Break Protection)

A small d-c voltage is available at the TCB+ and TCB– terminals on the instrument case rear terminal board. This voltage can be connected directly across a thermocouple without affecting the meter indication. The thermocouple will keep this TCB voltage shorted as long as it is in good operating condition. If the thermocouple fails (open circuit), the TCB voltage is no longer shorted and will drive the indicator to the upscale stop.

4.3 PRINTED CIRCUIT BOARD

4.3.1 Oscillator Circuit

The circuit of Q1 is a 15 to 20 MHz oscillator with resonant tank circuits in both the emitter and the base circuits. The base circuit inductance is controlled by the two flat coils mounted on the setpointer arm. A metal flag suspended from the temperature pointer is free to pass between the two coils on the setpointer to reduce their inductance. As the base circuit inductance changes the frequency of the base circuit also changes. The base circuit frequency and the emitter circuit frequency affects the amount of direct current flowing through Q1. Minimum current flows in Q1 when the flag is fully into the pickup coils (minimum inductance). Emitter circuit frequency is adjusted by either L2 or the reset capacitor C7.

The slowly changing current of Q1 with normal control will cause relay chatter unless a detent voltage prevents it. This small amount of detent voltage is the bias current for Q1 through R4.

Table 1-1 shows the models which have time proportioning action. Proportioning action in these models is accomplished by changing the tuning of the oscillator by means of the voltage variable capacitor D2 shown on Figure 6-4. Varying the voltage on D2 changes its capacitance, which varies the frequency of the emitter tank circuit. Time proportioning action occurs when the flag is between the pickup coils. The position of the flag between the coils determines the percent of on time during one cycle. As the Process Indicator moves upscale towards the control setpoint, the percent on time decreases and the percent off time increases.

4.3.2 DC Amplifier

The output of the oscillator is connected through D3 and R6 to the base of Q2. The output of Q2 goes through C11 and then through R16 and R30 which are inputs to the Phantom Schmidt (Q4, Q5) and Fixed Schmidt (Q6, Q7), respectively.

4.3.3 Schmidt Triggers

The Schmidt trigger circuits control relay action. The input to the Schmidt Triggers are so biased that when the output of the DC Amplifier is reduced or at a minimum, relays K1 and K2 are de-energized. When the output of the DC Amplifier increases to a certain level one of the Schmidt Triggers changes state, energizing one relay. When the output of the DC Amplifier increases even further, the remaining Schmidt Trigger will change state, energizing the other relay. The control span between the actuation of the two relays is dependent upon the setting of the SPREAD control R22.

SECTION 5
SERVICE

5.1 GENERAL

Calibration paragraph 5.2 outlines a procedure for the internal adjustments of the Controller. Paragraph 5.3 gives a general troubleshooting procedure.

5.2 CALIBRATION

5.2.1 General

The calibration adjustments are factory set and normally do not require readjustment. See Table 5-1 for a Summary of adjustments.

The following equipment is required: VOM with a sensitivity of 20,000 ohms per volt and insulated alignment screwdrivers.

Go through the calibration steps in order. Remove controller chassis from its housing. Figures 6-5 and 6-6 show backboard terminals for power and other connections. Proceed as follows.

Table 5-1. Summary of Adjustments

Symbol	Location	Description of Adjustments
L2	PCB	Oscillator Frequency
R21	PCB	Spread Limit Adjust (Minimum for 273A, A1, A2, A3) (Maximum for 273A-4, A-5, A-6, A-7)
R23	PCB	Spread Limit Adjust (Maximum for 273A, A-1, A-2, A-3) (Minimum for 273A-4, A-5, A-6, A-7)
R46	PCB	Schmidt Trigger Deadband (Low point on A, A-1, A-2, A-3) High point on A-3, A-4, A-5, A-6)
R47	PCB	Schmidt Trigger Deadband (High point on A, A-1, A-2, A-3) (Low point on A-3, A-4, A-5, A-6)
C7	Front Panel	Reset Control Adjusts emitter circuit frequency
R22	Front Panel	Spread Control. Adjusts the scale distance between where the low and high point relays operate.
R44	Front Panel	Cycle Time Control Adjusts relay operating cycle time

5.2.2 Procedure

Proceed as follows:

1. Make power connections.
2. Insulate the center relay contact from both NO and NC relay contacts by placing a paper strip between the contacts.
3. Turn the front panel SPREAD potentiometer R22 fully CCW.
4. Turn the front panel CYCLE TIME potentiometer R44 fully CCW.
5. Turn the RESET capacitor C7 to its midpoint position.
6. Align the green setpoint pointer until it coincides with the red meter temperature pointer.
7. Turn the slug of the oscillator coil L2 until relay K1 just operates (Models 273A, A-4) or cycles on and off equally (Models 273A-1, -2, -3, -5, -6 and -7).
8. By moving the setpoint in small increments, adjust R46 until the fixed point deadband (K1) is about 0.25% of full scale. This is a difficult adjustment.
9. By moving the setpoint in small increments, adjust R47 until the phantom point deadband (K2) is about 0.25% of full scale. This is a difficult adjustment.
10. Re-align the green setpoint pointer until it coincides with the red meter temperature pointer.
11. Again perform step 7.
12. Record the scale distance between the operation of relays K1 and K2 after slowly moving the setpoint.
13. Either adjust R23 (Models 273A, -1, -2, and -3) or R21 (Models 273A-4, -5, -6, and -7) until the maximum spread between the relay operating points is approximately 30% of full scale. Either R21 or R23 may be the maximum (or minimum) spread adjustment depending upon the model.
14. Turn the front panel SPREAD potentiometer R22 fully CCW.
15. Again perform step 12.
16. Either adjust R23 (Models 273A, -1, -2, and -3) or R21 (Models 273A-4, -5, -6, and -7) until the minimum spread between the relay operating points is 0.25% of full scale. Do not cross over the fixed and phantom operating points.
17. Resistors R21 and R23 have an interacting effect. Repeat steps 13, 14, 15, and 16 until the maximum and minimum spreads are met.
18. Seal all adjustments.

5.3 METER–CHASSIS ALIGNMENT

Perform this adjustment after replacing either meter or chassis.

1. Make power connections.
2. Align the green setpoint pointer until it coincides with the red meter temperature pointer.
3. With a small screwdriver, turn the RESET control C7 to the midpoint of its range.
4. Adjust L1 on the PCB until one of the following conditions is reached.
   A. Models A-1, A-3, A-6, and A-7: for equal cycling of the right pilot light I2.
   B. Models A-2 and A-4: for the point where the right pilot light I2 just turns off.
   C. Models A and A-5: for the point where the left pilot light I1 just turns off.
5. Seal L1 with red enamel.
6. Disconnect power connections.

5.4 TROUBLESHOOTING

Be certain the Controller is at fault before going through a lengthy and perhaps unnecessary troubleshooting procedure. Check the operation of other instruments in the system.

If the relays chatter the deadband adjustment of resistors R46 and R47 may be too narrow. If relay cycling is irregular or unpredictable at minimum spread only, the adjustment of R21 (Models 273A, -1, -2, and -3) or R23 (Models 273A-4, -5, -6, and -7) is set too narrow and the relay operating points are crossed over. On the Models 273A-5, -6, and -7 if the Phantom Point cycles with the indicator well downscale from the setpoint, the maximum spread adjustment of R21 is set too wide and should be readjusted.

Look for loose wires. Be certain all plug-in boards and pins are firmly seated.

Do not attempt to make major repairs on the PC Board. Minor repairs such as replacing broken pins may be made. When making repairs on printed circuit boards or soldering transistor or integrated circuit terminals, use a 35 watt or less soldering iron and 63/37 or 60/40 resin core solder.

In any continuity tests with the ohmmeter, be certain all power is removed from the Controller. Do not use the lower ranges of an ohmmeter since the internal battery in the ohmmeter may cause excessive current drain through transistors. If the Hewlett-Packard Model 427A Multi-Function Meter is available, use it for continuity tests because of the lower current drain of its ohmmeter. Do not apply too much pressure to the printed circuit board pins.

Diodes and transistors when they fail usually short circuit. The following applies to diodes and to transistors measured Collector to Base or Base to Emitter. If an ohmmeter reads zero ohm in both cases when its probes are reversed across a component, the component is shorted. An ohmmeter indicating a high resistance in one direction will usually mean that the component is good. A reading of infinite resistance in both cases means that the component is open and defective.

5.5 SERVICE INFORMATION

For any service information please call either your local Industrial Instruments Division office or the sales office at Rockford. A phone call may save unnecessary attempts at repair.

SECTION 6
PARTS LISTS AND DIAGRAMS

Table 6-1. Electrical Parts on PCB's

Symbol	Part Number	Description
	CAPACITORS	
C1,2,5	39-415	250 ρ F 20%, 500 WVDC
C3	39-419	20 ρ F 2%, 600 WVDC
C4	39-068	39 ρ F 5%, 600 WVDC (273A, -4)
C4	39-413	27 ρ F 5%, 100 WVDC (273A-1, -2, -3, -5, -6, -7)
C6		NOT USED (273A, -4)
C6	39-155	10 ρ F 5%, 600 WVDC (273A-1)
C6	39-013-1	15 ρ F 10%, 600 WVDC (273A-2, -5, -6)
C6	39-067-1	30 ρ F 5%, 600 WVDC (273A-3, -7)
C7	39-411-1	2.2/1.8 ρ F min. to 11.8/14.4 ρ F max., Reset capacitor
C9	39-102-1	.001 μ F 5%, 500 WVDC
C10,11,14	39-153	50 μ F 10%, +150%, 50 WVDC
C12	39-427	250 μ F -10% +150%, 50 WVDC
C15,16		NOT USED (273A, -4)
C15	39-260	56 μ F 20%, 15 WVDC
C16	39-153	50 μ F -10% +150%, 50 WVDC
C17	39-196	.22 μ F 20%, 100 WVDC
C19	CYZR-680	32 μ F +50% -10%, 40 WVDC
C20		NOT USED (273A, -4)
C20	39-262	5 ρ F 10%, 500 WVDC
	DIODES	
D1	37-148	.5 to .62V, 400 μ A
D2	37-60	Voltage Variable Capacitor, 33 p F at 4 Vdc, type IN3182 (273A-1, -2, -3, -5, -6 and -7)
D2,5,7,19		NOT USED (273A, -4)
D3	37-93	Zener, 12V ±5%, 400 mW, type IN759
D4,5,6,7,8,9, 10,11,12,13, 14,15,16,17, 18,19,20,21	EYZP-384	60 PIV 100 mA,
D17		NOT USED
D18	37-096-2	Zener, 15V 5%, 3 W
	INDUCTANCES	
L1	41-136	Choke, 43 μ H 10%
L2	41-130	Variable, 1.2 μ H to 2.7 μ H
	TRANSISTORS	
Q1	EYZP-623	2N4126
Q2,4,5,6,7	31-82	2N3416
	RESISTORS	
Resistors are 10% tolerance, 1/2W, unless stated otherwise.		
R1	40-1578	390 ohms
R2,18,32,38	40-1950	22k
R3	40-1778	270 ohms
R4	CYZR-481-300	220 ohms
R5,19,35	CYZR-481-100	10k
R6	CYZR-479	820 ohms
R7	40-1940	470 ohms
R8	40-1758	120 ohms
R9	CYZR-170-38	5.6k, 1/2W
R10	CYZR-170-26	1.5k, 1/2W
R11		NOT USED (273A, -4)
R11	40-1784	150 ohms, 1%, 1/2W
R12,13	CYZR-170-27	100 ohms, 1/2W
R14,15		NOT USED (273A, -4)
R14	40-1762	82k (273A-1, -2, -3, -5, -6)

Table 6-1. Continued

Symbol	Part Number	Description
	RESISTORS	
R14	CYZR-481-200	56k (273A-7)
R15	CYZR-592-13	220 ohms 1%, 3W (273A-1, -2, -3, -5, -6)
R15	CYZR-326-35	250 ohms 1%, 3W (273A-7)
R16,30	CYZR-481-30	1.2k
R17,27,29,31, 34,36	CYZR-481-40	4.7k
R20,24	CYZR-171-6	220 ohms, 1W
R21	BYZR-162-2	Potentiometer, 15k 30%, 1/4W
R23	BYZR-162-3	Potentiometer, 100k 30%, 1/4W
R25	40-1764	18k
R26	CYZR-481-150	1.5k
R28,39	CYZR-481-350	4.7k
R37	40-1922	6.8k
R40	40-1924	680 ohms, 1W
R42,43		NOT USED (273A, -4)
R42	40-1756	10k 5% (273A-1, -5)
R42	40-1757	39k 5% (273A-2, -3, -6, -7)
R43	CYZR-481-240	2.7k ohms 5% (273A-1, -5)
R43	40-1756	10k ohms 5% (273A-2, -3, -6, -7)
R45		NOT USED (273A, -4)
R45	40-1763	1M
R46,47	BYZR-158-1	Potentiometer, 20 ohms 20%, 2W
	TRANSFORMERS	
T1,T2	30-313	Power
	SOCKETS	
—	34-748	Pilot Light Sockets
	CONNECTORS	
—	A-6338	Meter Plug Assembly

Table 6-2. Electrical Parts Not on PCB's

Symbol	Part Number	Description
C8	39-098	1 μ F 20%, 250 WVDC
K1	A-5521	Relay (Part of Voltage Selection Board Assembly)
K2	A-5521-100	Relay (Part of Voltage Selection Board Assembly)
I1,I2	36-034	14V Incandescent (.12 mA max.)
—	A-3152	Line Compensating Resistor
R22	29-348	SPREAD CONTROL Potentiometer 5k ohms 20%, 1/2W (On all models)
R44	29-066	CYCLE TIME Potentiometer 2M ohms 20%, 1/2W (Only on 273A-1, -2, -3, -5, -6 and -7)

Table 6-3A. Parts List, Complete Assemblies, All Models

Description	Assembly Number
Chassis Backboard	A-6978-100
Access Door Assembly	A-6370
Case Assembly	A-6496
Upper Setpoint Stop Assembly	A-7197
Scale Pan Assembly	A-9133
Upper Meter Stop	A-6759
Housing and Cover	A-9137
Mounting Kit for Replacement Chassis	A-9083

Table 6-3B. Parts List, Assembly Numbers for Each Model

Description	Assembly Numbers For Each Model							
	273A	273A-1	273A-2	273A-3	273A-4	273A-5	273A-6	273A-7
Circuit Board Assembly	A-9897	A-9898	A-9898-100	A-9898-200	A-9897	A-9898-300	A-9898-400	A-9898-500
Voltage Selection Board	A-9899	A-9900	A-9900	A-9900	A-9899	A-9900	A-9900	A-9900
Chassis	A-9893	A-9894	A-9894-100	A-9894-200	A-9893-100	A-9894-300	A-9894-400	A-9894-500
Indicator	A-9193	A-9193	A-9193	A-9193	A-9194	A-9194	A-9194	A-9194
Meter Movement	A-9168	A-9168	A-9168	A-9168	A-9169	A-9169	A-9169	A-9169
Movable Element Assembly	A-9158	A-9158	A-9158	A-9158	A-9159	A-9159	A-9159	A-9159

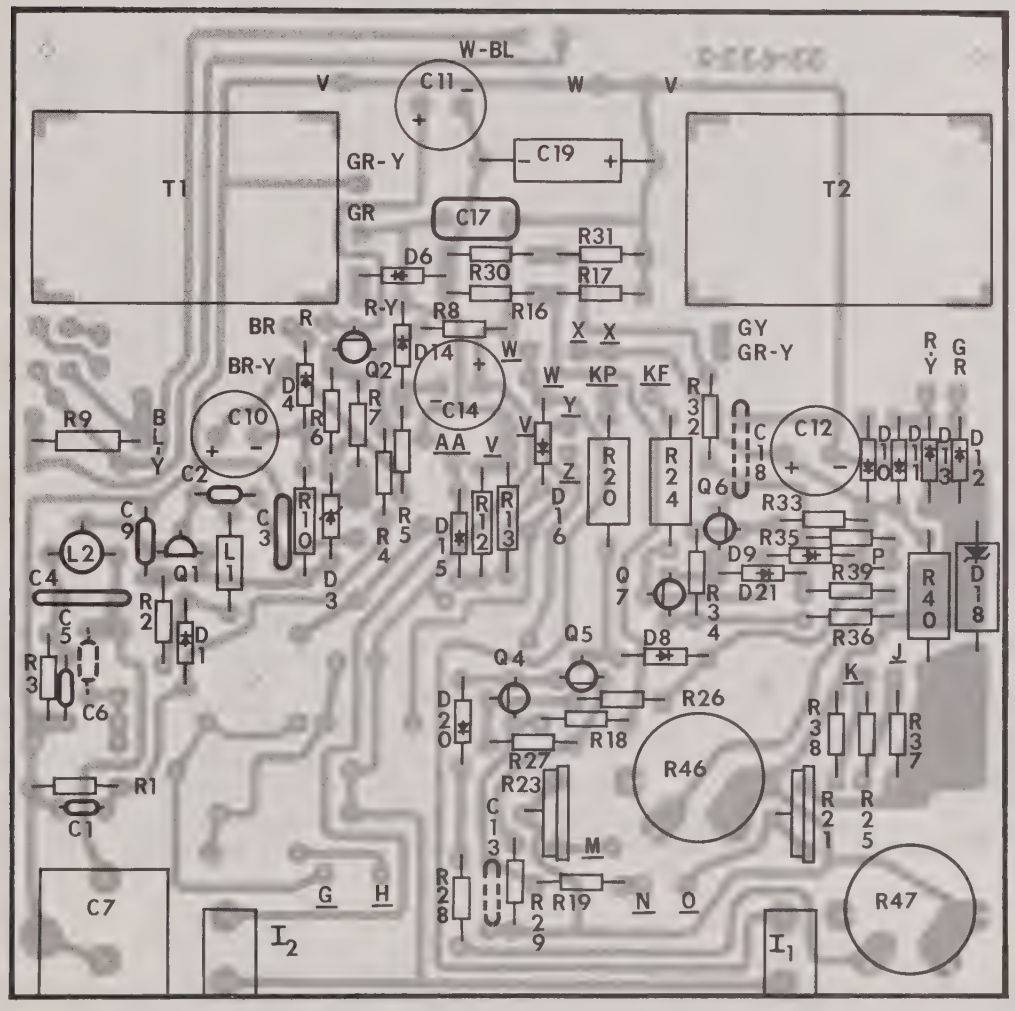


Figure 6-1. Printed Circuit Board Parts Location, Models 273A and 273A-4

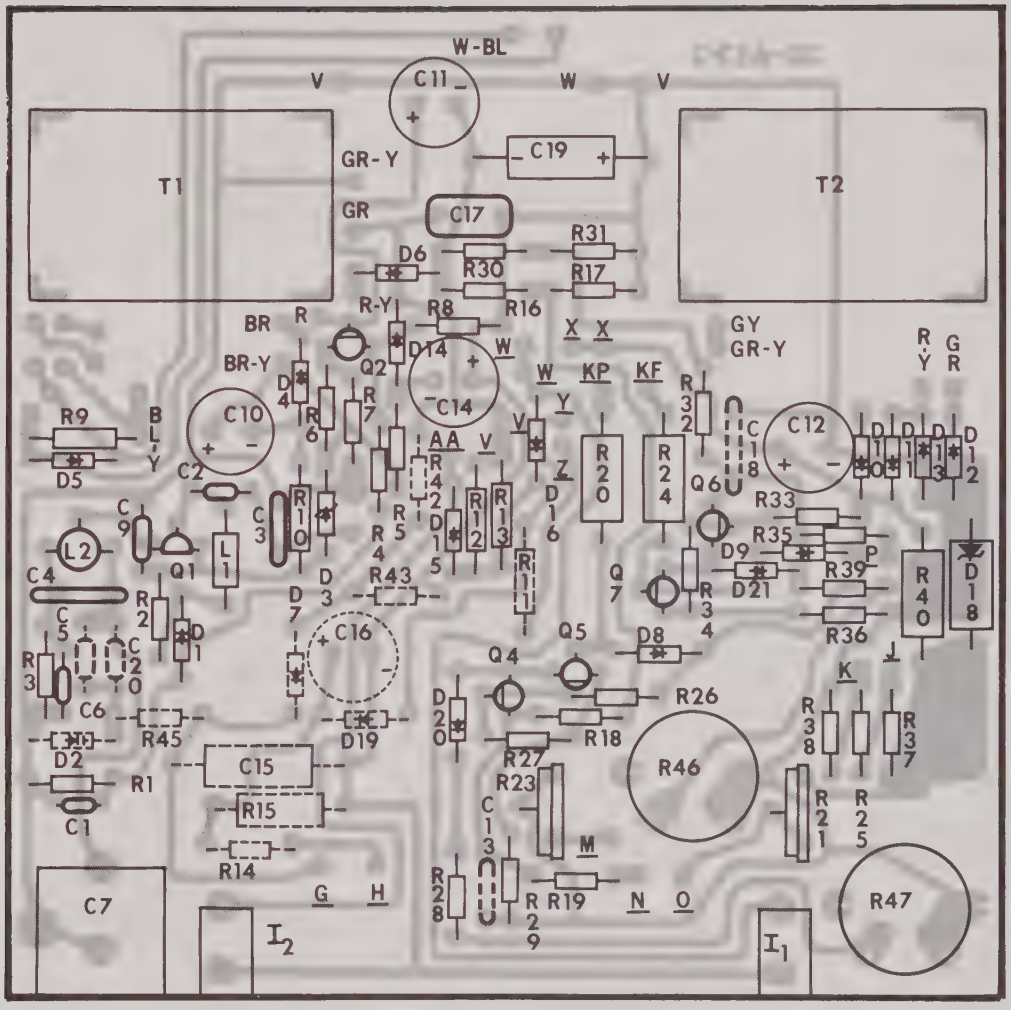
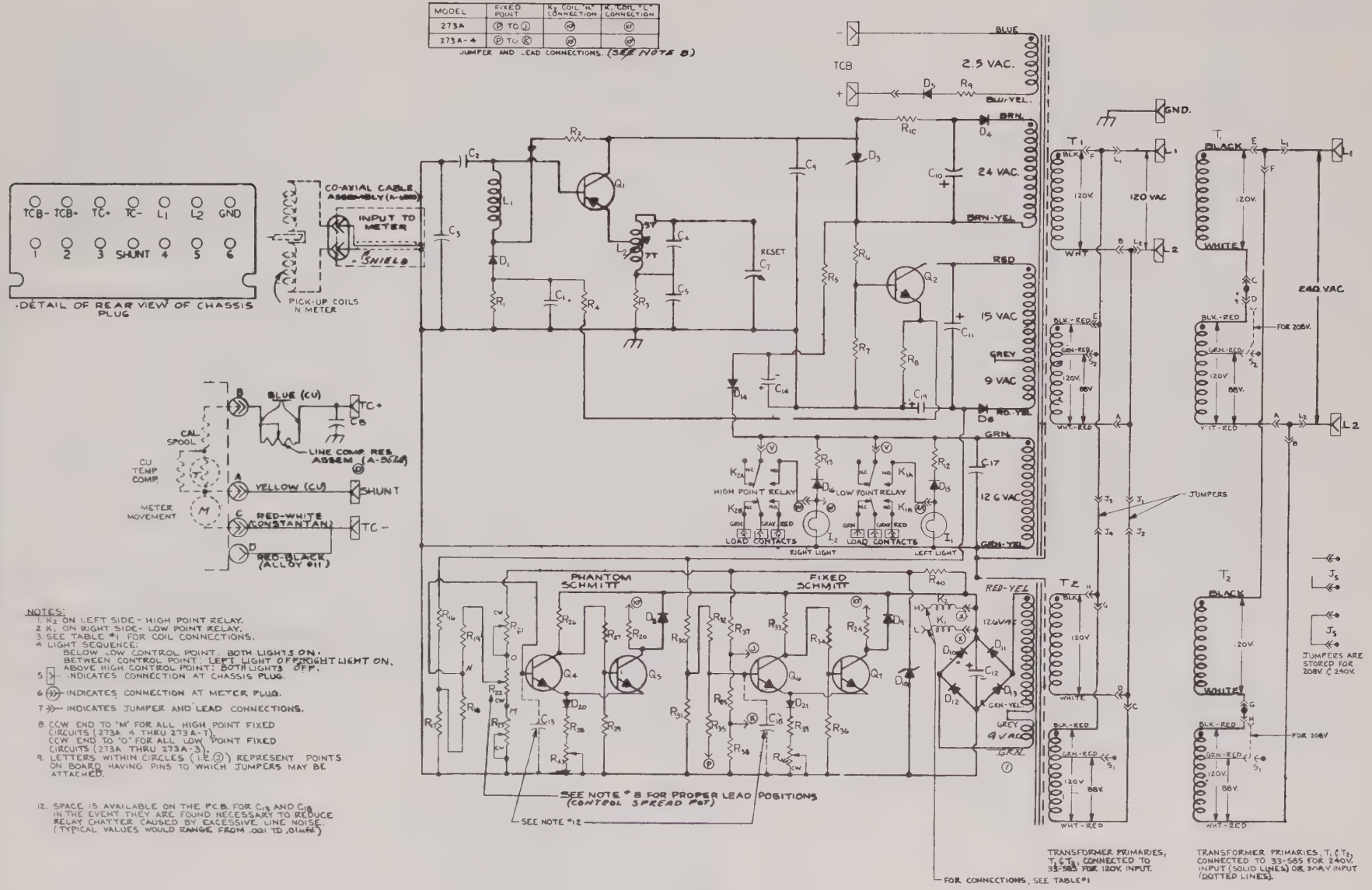


Figure 6-2. Printed Circuit Board Parts Location Models 273A-1, -2, -3, -5, -6 and -7



NOTES:
1. K_2 ON LEFT SIDE - HIGH POINT RELAY.
2. K_1 ON RIGHT SIDE - LOW POINT RELAY.
3. SEE TABLE #1 FOR COIL CONNECTIONS.
4. LIGHT SEQUENCE:
   BELOW LOW CONTROL POINT, BOTH LIGHTS ON.
   BETWEEN CONTROL POINT, LEFT LIGHT OFF, RIGHT LIGHT ON.
   ABOVE HIGH CONTROL POINT, BOTH LIGHTS OFF.
5. INDICATES CONNECTION AT CHASSIS PLUG.
6. INDICATES CONNECTION AT METER PLUG.
7. INDICATES JUMPER AND LEAD CONNECTIONS.
8. CCW END TO "M" FOR ALL HIGH POINT FIXED CIRCUITS (273A 4 THRU 273A-7).
   CCW END TO "O" FOR ALL LOW POINT FIXED CIRCUITS (273A THRU 273A-3).
9. LETTERS WITHIN CIRCLES (I.E. Ⓝ) REPRESENT POINTS ON BOARD HAVING PINS TO WHICH JUMPERS MAY BE ATTACHED.

12. SPACE IS AVAILABLE ON THE P.C.B. FOR C_{13} AND C_{16} IN THE EVENT THEY ARE FOUND NECESSARY TO REDUCE RELAY CHATTER CAUSED BY EXCESSIVE LINE NOISE. (TYPICAL VALUES WOULD RANGE FROM .001 TO .01 μF.)

Figure 6-3. Schematic, Models 273A and 273A-4

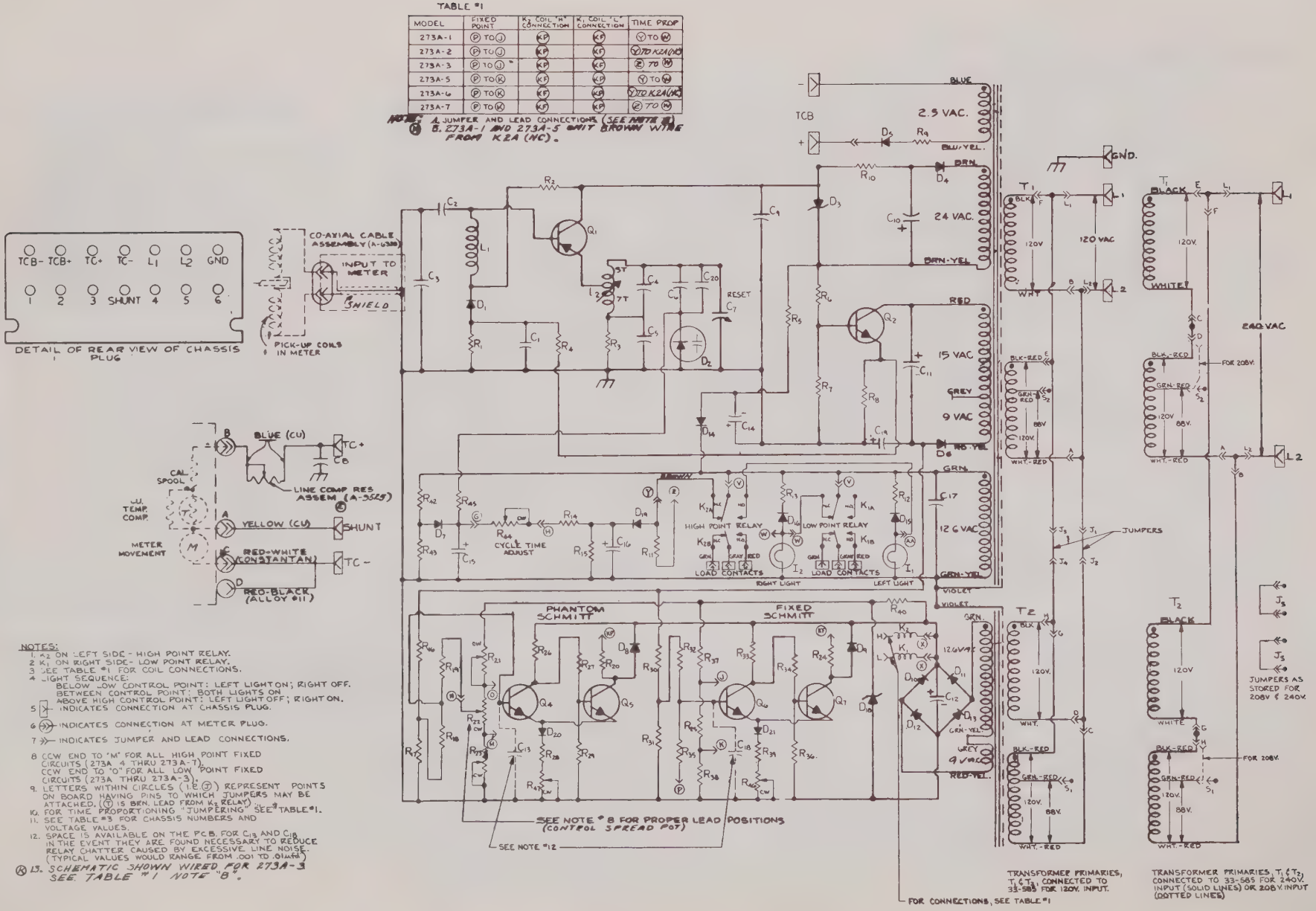


TABLE #1
MODEL | FIXED POINT | K2 COIL "M" CONNECTION | K1 COIL "L" CONNECTION | TIME PROP
273A-1 | P TO J | KF | KF | Y TO W
273A-2 | P TO J | KF | KF | Y TO K2A(NC)
273A-3 | P TO J | KF | KF | Z TO W
273A-5 | P TO K | KF | KF | Y TO W
273A-6 | P TO K | KF | KF | Y TO K2A(NC)
273A-7 | P TO K | KF | KF | Z TO W
NOTE: A. JUMPER AND LEAD CONNECTIONS (SEE NOTE 8)
B. 273A-1 AND 273A-5 OMIT BROWN WIRE FROM K2A (NC).
TCB- TCB+ TC+ TC- L1 L2 GND
1 2 3 SHUNT 4 5 6
DETAIL OF REAR VIEW OF CHASSIS PLUG
CO-AXIAL CABLE ASSEMBLY (A-6328)
INPUT TO METER
SHIELD
PICK-UP COIL IN METER
CAL. SPOOL
W. TEMP. COMP.
METER MOVEMENT
BLUE (CU)
YELLOW (CU)
RED-WHITE (CONSTANTAN)
RED-BLACK (ALLOY #11)
SHUNT
TC+
TC-
LINE COMP RES ASSEM (A-3529)
TCB
2.5 VAC.
BLUE
BLU/YEL.
GND.
BRN.
24 VAC.
BRN-YEL
RED
15 VAC
GREY
9 VAC
RED-YEL
GRN.
12.6 VAC
GRN-YEL
VIOLET
HIGH POINT RELAY
LOW POINT RELAY
LOAD CONTACTS
RIGHT LIGHT
LEFT LIGHT
CYCLE TIME ADJUST
RESET
PHANTOM SCHMITT
FIXED SCHMITT
SEE NOTE "8 FOR PROPER LEAD POSITIONS (CONTROL SPREAD POT)
SEE NOTE "12
FOR CONNECTIONS, SEE TABLE "1
JUMPERS
JUMPERS AS STORED FOR 208V & 240V.
120V
120 VAC
240 VAC
FOR 208V.
WHT.
WHT.-RED
BLK.-RED
GRN.-RED
BLK.
WHITE
TRANSFORMER PRIMARIES, T1 & T2 CONNECTED TO 33-585 FOR 120V. INPUT.
TRANSFORMER PRIMARIES, T1 & T2 CONNECTED TO 33-585 FOR 240V. INPUT (SOLID LINES) OR 208V. INPUT (DOTTED LINES)

NOTES:
1. K2 ON LEFT SIDE - HIGH POINT RELAY.
2. K1 ON RIGHT SIDE - LOW POINT RELAY.
3. SEE TABLE #1 FOR COIL CONNECTIONS.
4. LIGHT SEQUENCE:
   BELOW LOW CONTROL POINT: LEFT LIGHT ON; RIGHT OFF.
   BETWEEN CONTROL POINT: BOTH LIGHTS ON
   ABOVE HIGH CONTROL POINT: LEFT LIGHT OFF; RIGHT ON.
5. ⊣ INDICATES CONNECTION AT CHASSIS PLUG.
6. ⊗ INDICATES CONNECTION AT METER PLUG.
7. ⋙ INDICATES JUMPER AND LEAD CONNECTIONS.
8. CCW END TO "M" FOR ALL HIGH POINT FIXED CIRCUITS (273A-4 THRU 273A-7).
   CCW END TO "O" FOR ALL LOW POINT FIXED CIRCUITS (273A THRU 273A-3).
9. LETTERS WITHIN CIRCLES (I.E. Ⓨ) REPRESENT POINTS ON BOARD HAVING PINS TO WHICH JUMPERS MAY BE ATTACHED. (Ⓡ IS BRN. LEAD FROM K2 RELAY) SEE TABLE #1.
10. FOR TIME PROPORTIONING "JUMPERING" SEE TABLE #1.
11. SEE TABLE #3 FOR CHASSIS NUMBERS AND VOLTAGE VALUES.
12. SPACE IS AVAILABLE ON THE P.C.B. FOR C_{13} AND C_{18} IN THE EVENT THEY ARE FOUND NECESSARY TO REDUCE RELAY CHATTER CAUSED BY EXCESSIVE LINE NOISE. (TYPICAL VALUES WOULD RANGE FROM .001 TO .01 μfd)
13. SCHEMATIC SHOWN WIRED FOR 273A-3 SEE TABLE "1 NOTE "8".

Figure 6-4. Schematic, Models 273A-1, -2, -3, -5, -6 and -7

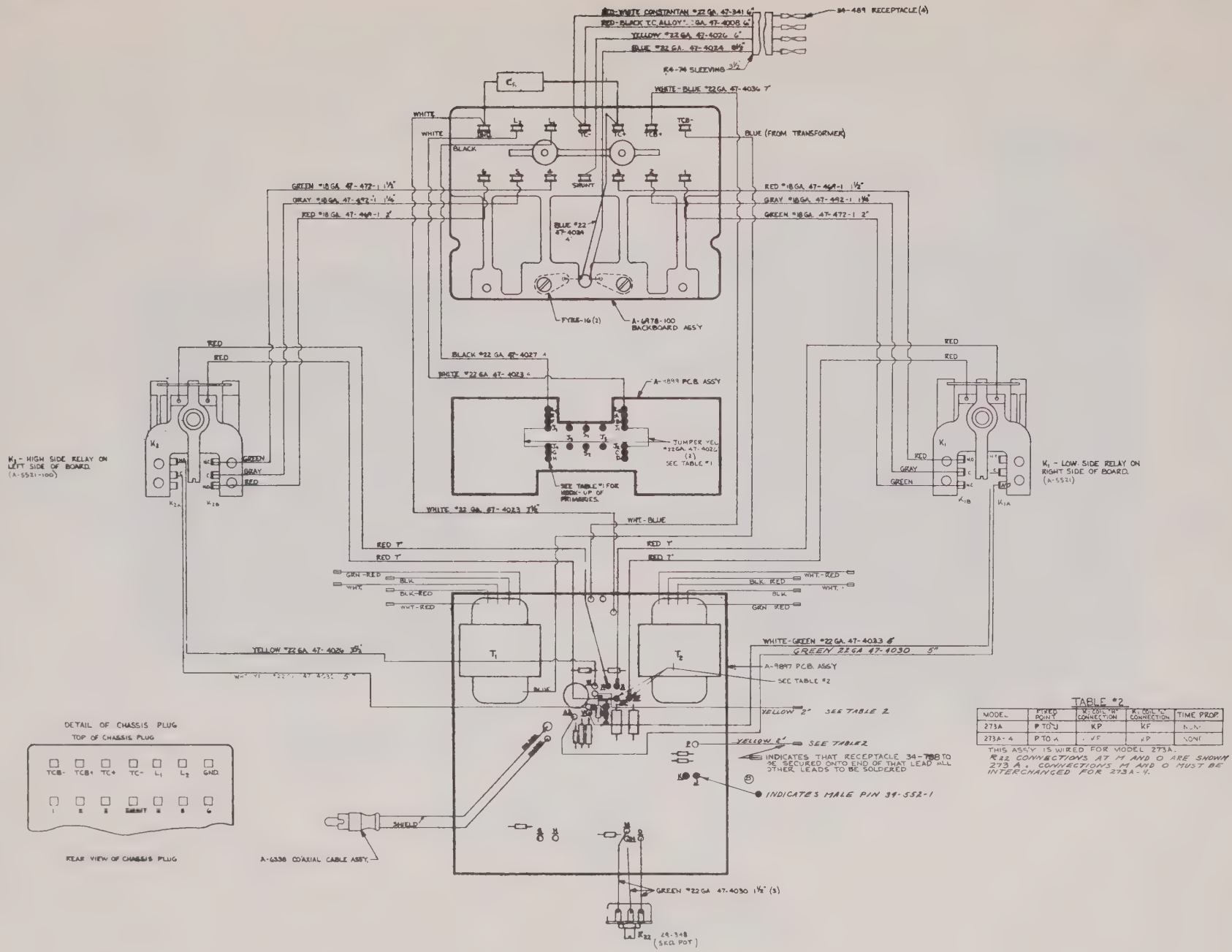

RED-WHITE CONSTANTAN #22 GA. 47-341 6"
RED-BLACK T.C. ALLOY #22 GA. 47-4008 6"
YELLOW #22 GA. 47-4026 6"
BLUE #22 GA. 47-4024 8½"
34-489 RECEPTACLE (4)
R4-74 SLEEVING 3½"
WHITE-BLUE #22GA 47-4034 7"
BLUE (FROM TRANSFORMER)
WHITE
BLACK
GREEN #18 GA 47-472-1 1½"
GRAY #18GA. 47-492-1 1½"
RED #18 GA 47-469-1 2"
RED #18GA. 47-469-1 1½"
GRAY #18GA. 47-492-1 1½"
GREEN #18GA. 47-472-1 2"
BLUE #22 47-4024 4"
FYBB-16 (2)
A-6478-100 BACKBOARD ASSY
BLACK #22 GA 47-4027 4"
WHITE #22 GA 47-4023 4"
A-4899 P.C.B. ASSY
JUMPER YEL #22GA 47-4025 (2) SEE TABLE #1
SEE TABLE #1 FOR HOOK-UP OF PRIMARIES.
WHITE #22 GA. 47-4023 7½"
WHT-BLUE
RED 7"
GRN-RED
BLK
BLK-RED
WHT-RED
BLK RED
WHT-RED
GRN RED
YELLOW #22 GA 47-4026 35½"
WHITE-GREEN #22 GA. 47-4033 6"
GREEN 22 GA 47-4030 5"
A-9897 P.C.B. ASSY
SEE TABLE #2
YELLOW 2" SEE TABLE 2
YELLOW 6" SEE TABLE 2
INDICATES THAT RECEPTACLE 34-788 TO BE SECURED ONTO END OF THAT LEAD ALL OTHER LEADS TO BE SOLDERED
INDICATES MALE PIN 34-552-1
K1 - HIGH SIDE RELAY ON LEFT SIDE OF BOARD. (A-5521-100)
K1 - LOW SIDE RELAY ON RIGHT SIDE OF BOARD. (A-5521)
DETAIL OF CHASSIS PLUG
TOP OF CHASSIS PLUG
TCB- TCB+ TC+ TC- L1 L2 GND
REAR VIEW OF CHASSIS PLUG
SHIELD
A-6338 COAXIAL CABLE ASSY.
GREEN #22 GA 47-4030 1½" (3)
R22 29-348 (SEQ POT)

TABLE #2

MODEL	FIXED POINT	K1 COIL "M" CONNECTION	K1 COIL "O" CONNECTION	TIME PROP
273A	P TO J	KP	KF	N.A.
273A-4	P TO A	KF	KP	NONE

THIS ASSY IS WIRED FOR MODEL 273A. R22 CONNECTIONS AT M AND O ARE SHOWN FOR 273A-1. CONNECTIONS M AND O MUST BE INTERCHANGED FOR 273A-4.

Figure 6-5. Wiring Diagram, Models 273A and 273A-4

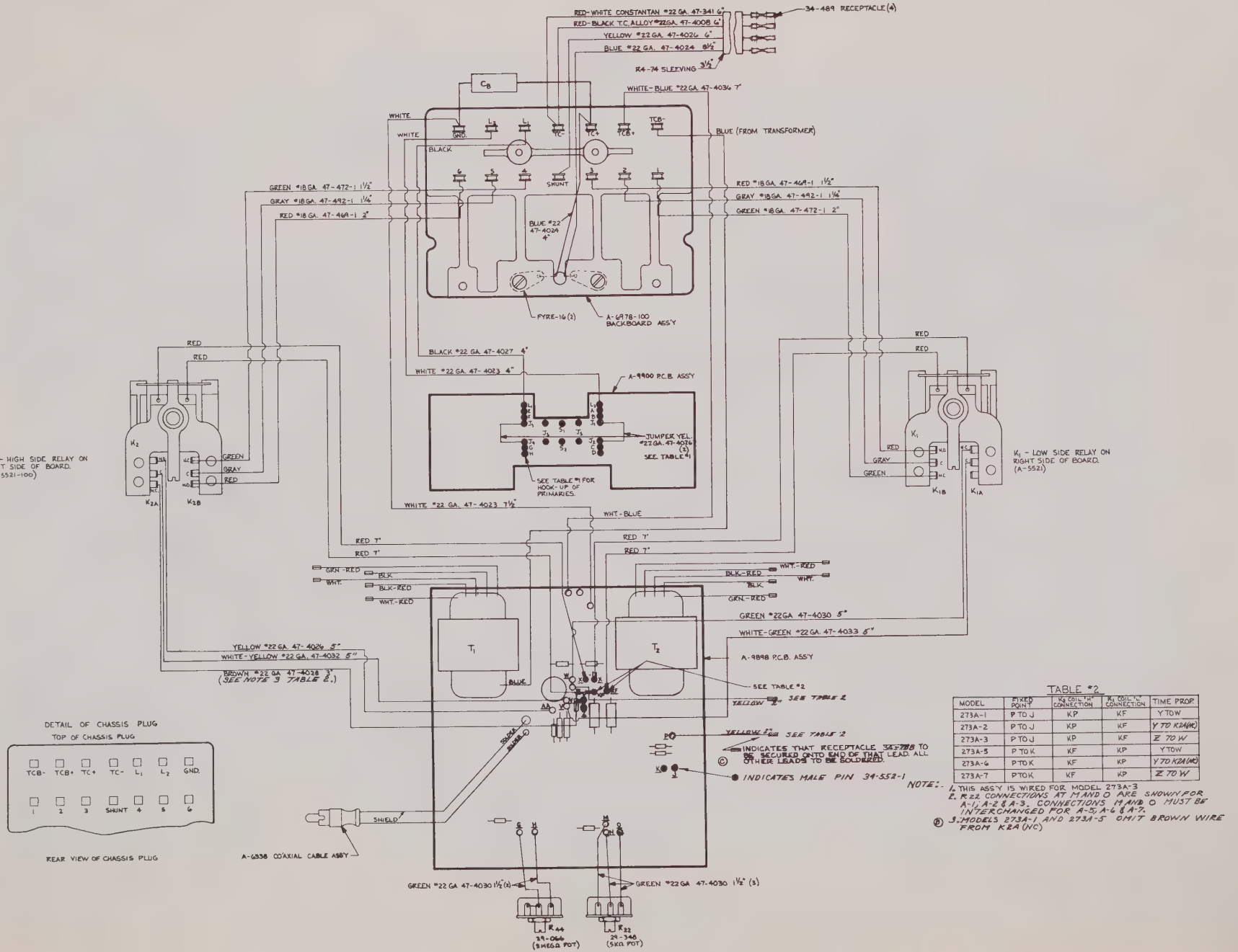
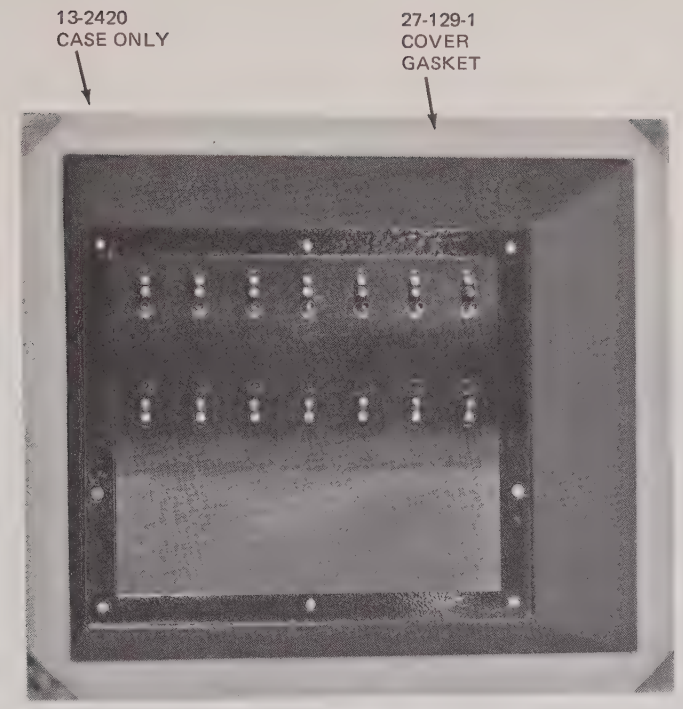


TABLE #2

MODEL	FIXED POINT	K1 COIL "K" CONNECTION	K1 COIL "C" CONNECTION	TIME PROP
273A-1	P TO J	KP	KF	Y TO W
273A-2	P TO J	KP	KF	Y TO K2A(NC)
273A-3	P TO J	KP	KF	Z TO W
273A-5	P TO K	KF	KP	Y TO W
273A-6	P TO K	KF	KP	Y TO K2A(NC)
273A-7	P TO K	KF	KP	Z TO W

NOTE:
1. THIS ASS'Y IS WIRED FOR MODEL 273A-3
2. R22 CONNECTIONS AT M AND O ARE SHOWN FOR A-1, A-2 & A-3. CONNECTIONS M AND O MUST BE INTERCHANGED FOR A-5, A-6 & A-7.
3. MODELS 273A-1 AND 273A-5 OMIT BROWN WIRE FROM K2A (NC)

Figure 6-6. Wiring Diagram, Models 273A-1, -2, -3, -5, -6 and -7



A-6394 CASE ASSEMBLY COMPLETE
(INCLUDES CASE, GASKET, AND
TERMINAL BOARD)

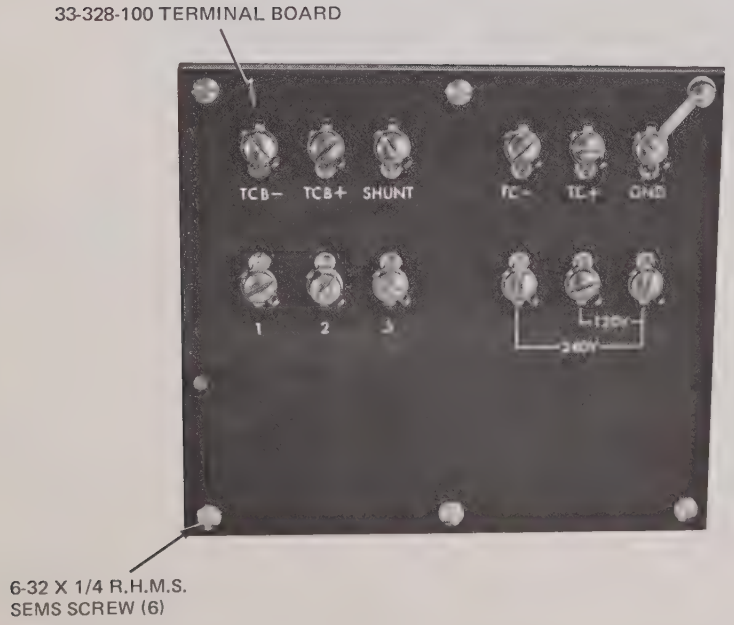


Figure 6-7. Replaceable Parts, Case Assembly

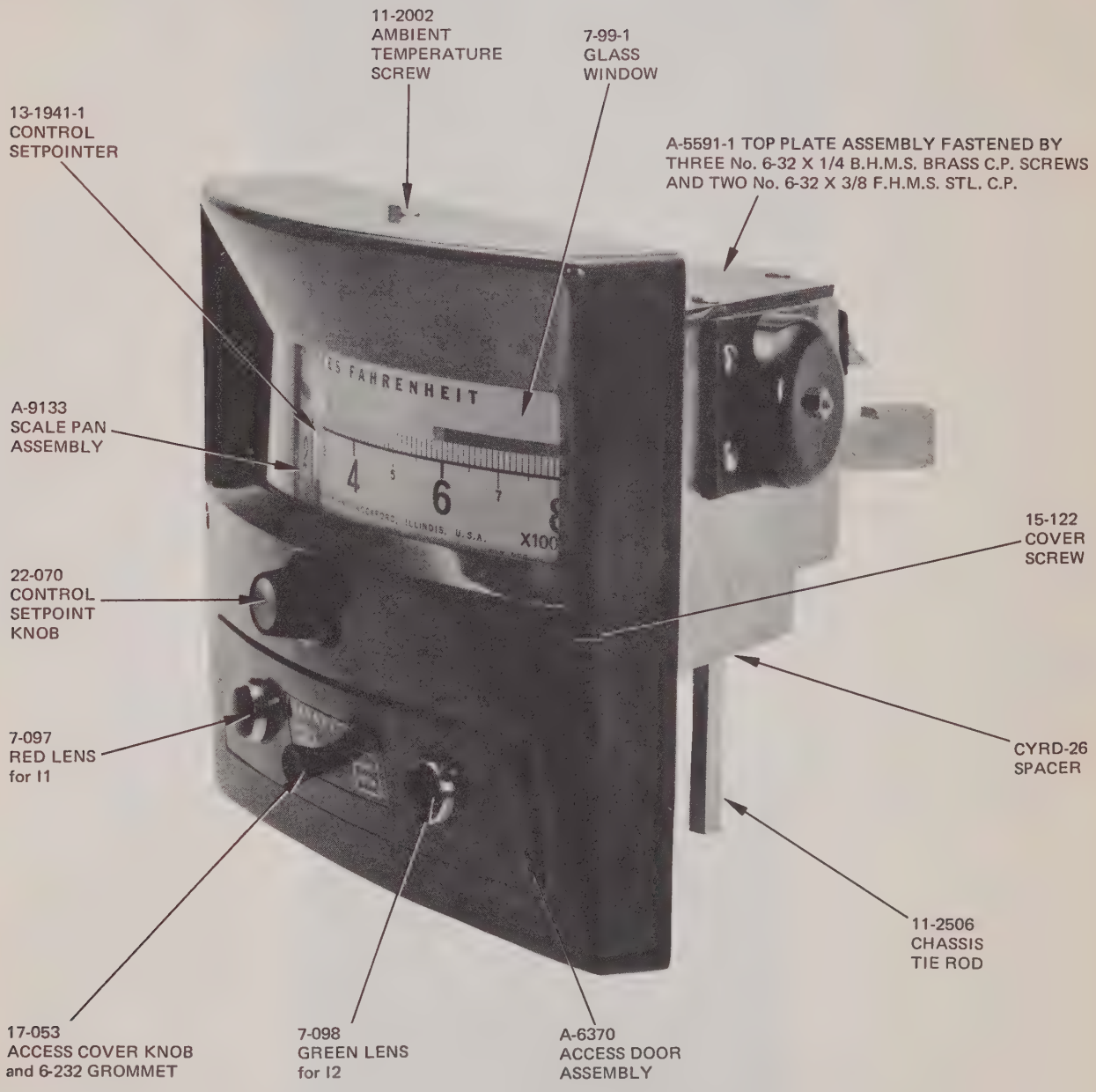


Figure 6-8. Replaceable Parts, Indicator Assembly, Front View

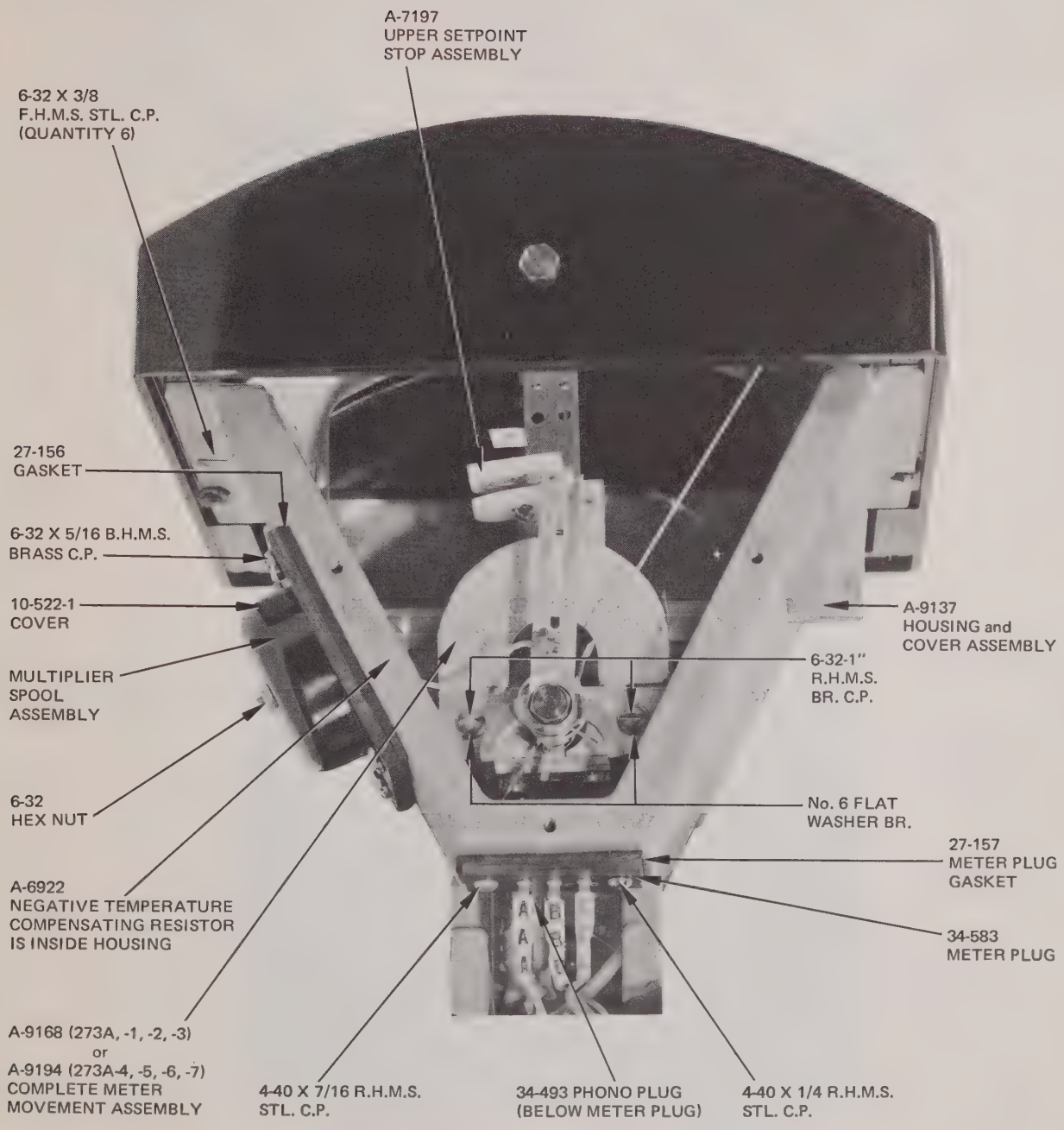


Figure 6-9. Replaceable Parts, Indicator Assembly A-9186, Top View

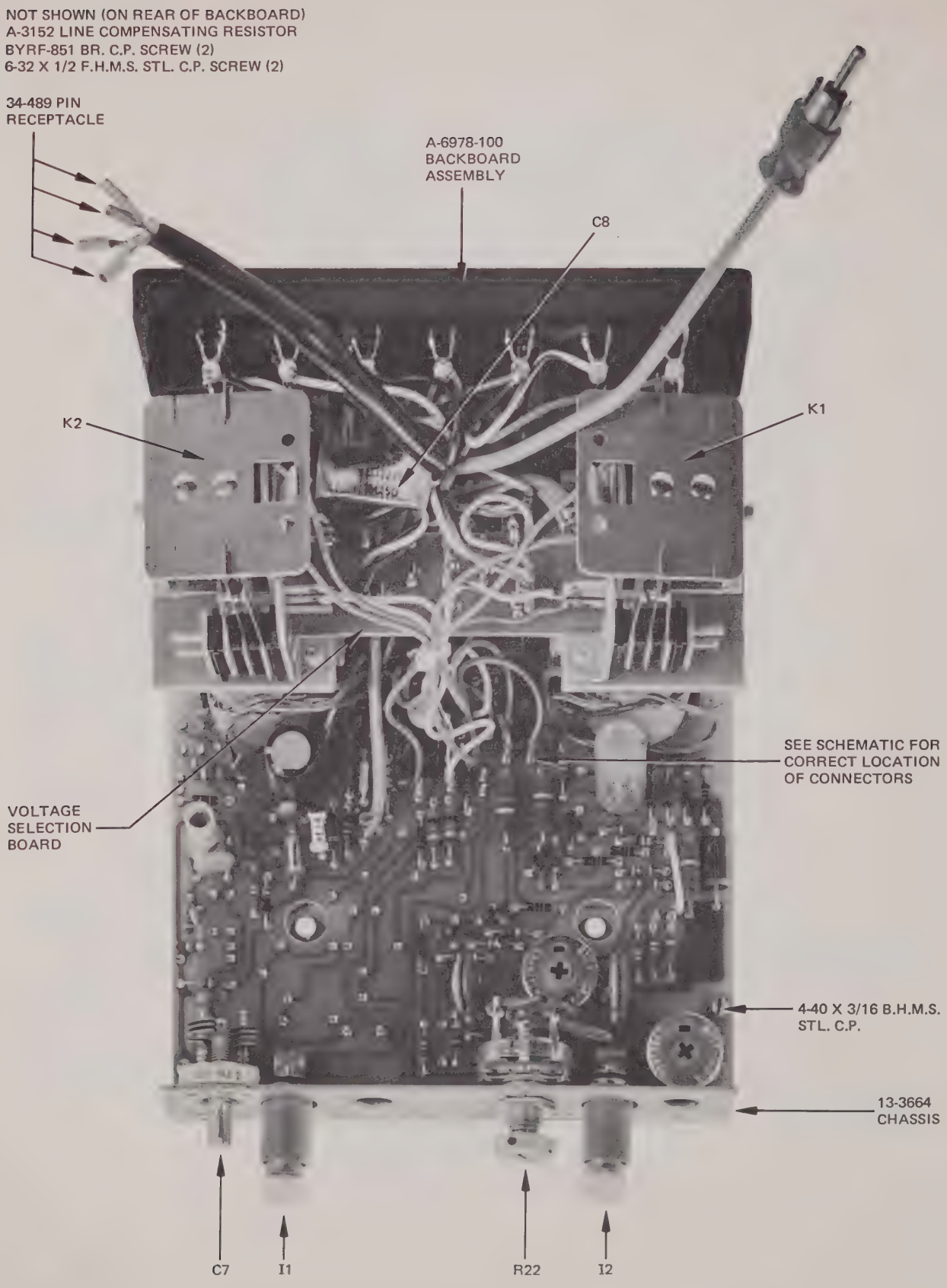


Figure 6-10. Replaceable Parts, Chassis Assembly, Models 273A and 273A-4

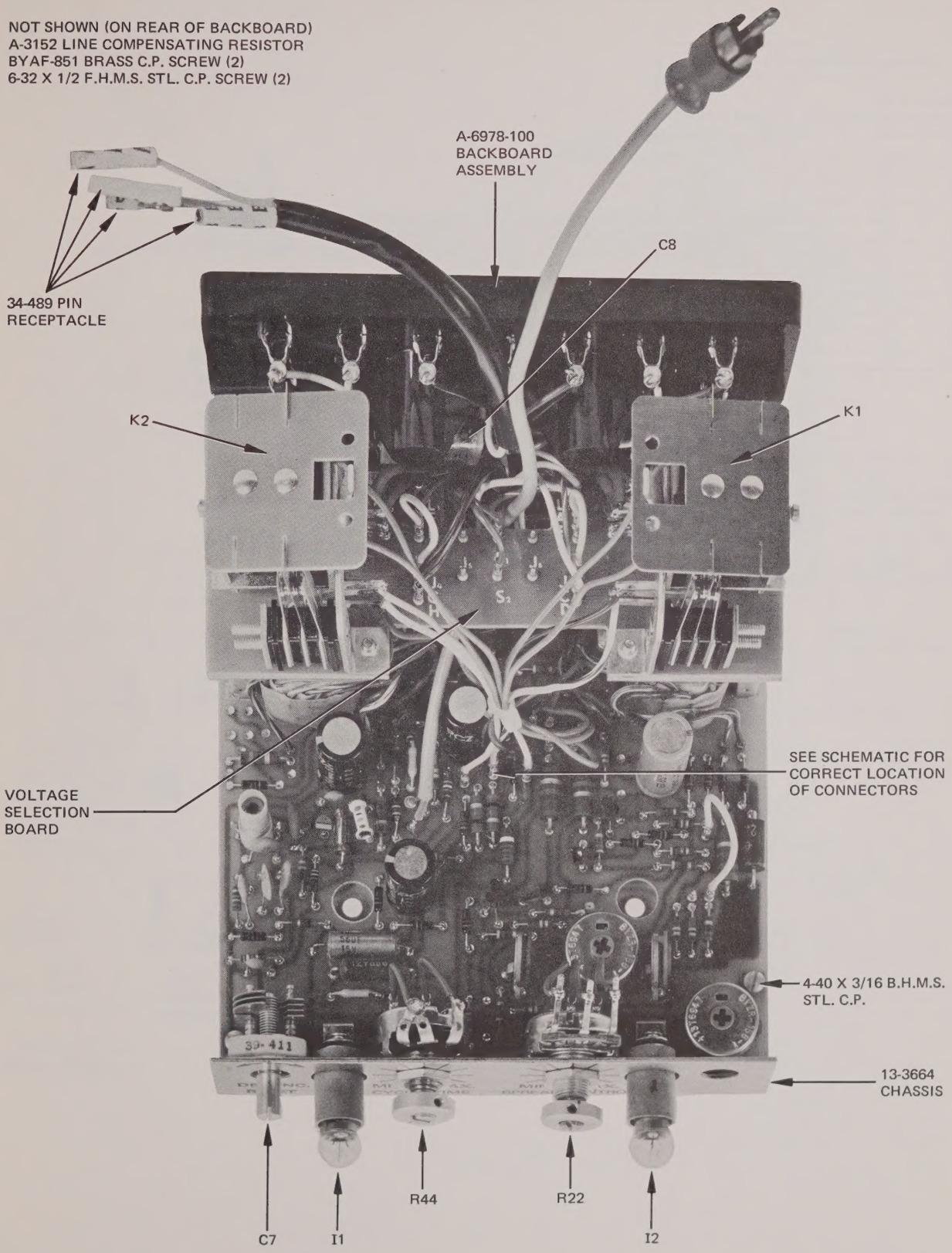


Figure 6-11. Replaceable Parts, Chassis Assembly, Models 273A-1, -2, -3, -5, -6 and -7

BIMETAL COMPENSATOR	
DEGREES COMPENSATED FOR	PART NUMBER
1.5	18-069-1
3	18-070-1
4	18-061-1
5	18-062-1
6	18-071-1
7	18-072-1
8	18-064-1
9	18-066-1
10	18-065-1
11	18-074-1
12	18-075-1
13	18-076-1

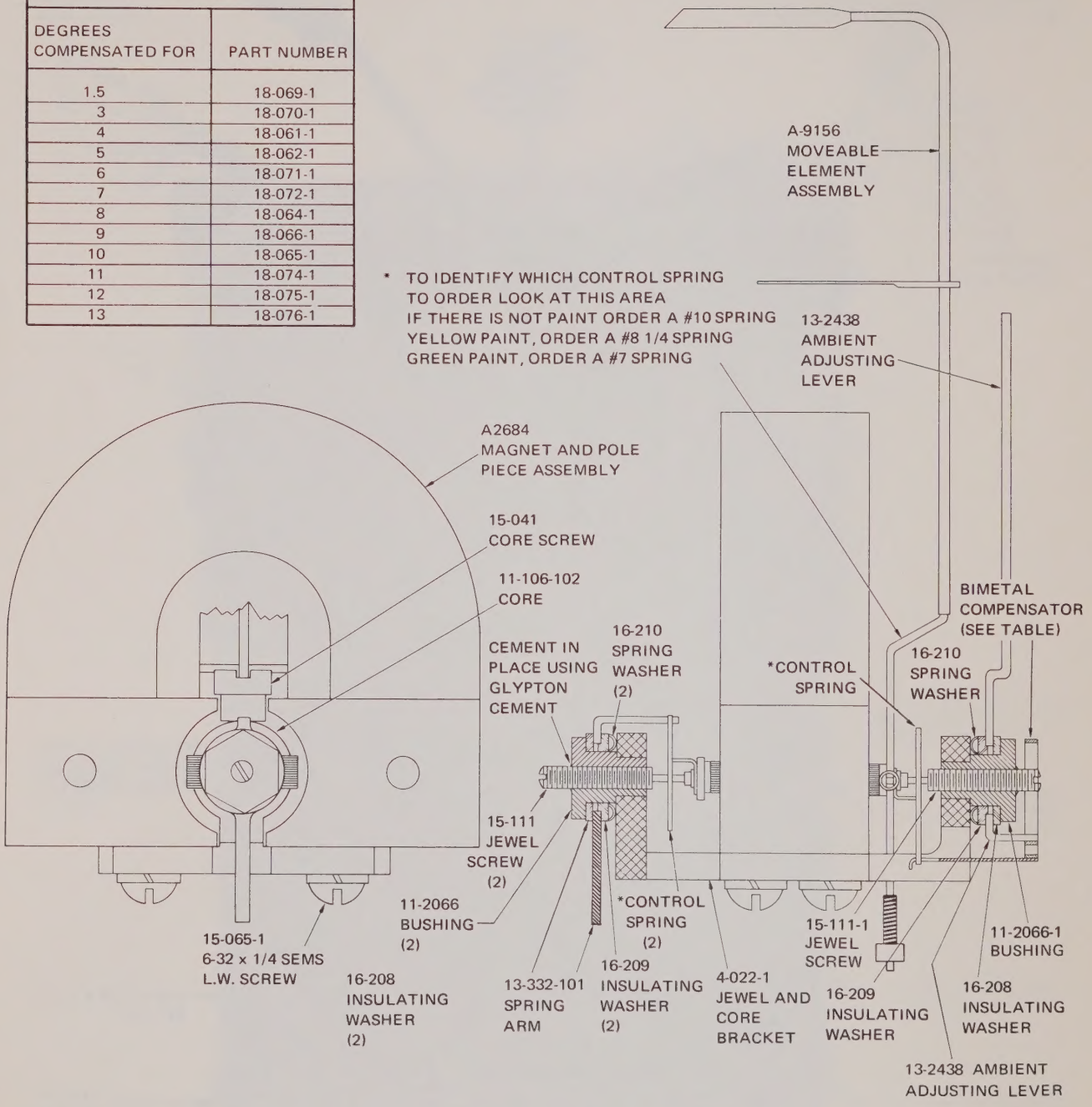


Figure 6-12. Replaceable Parts, Meter Movement Assembly

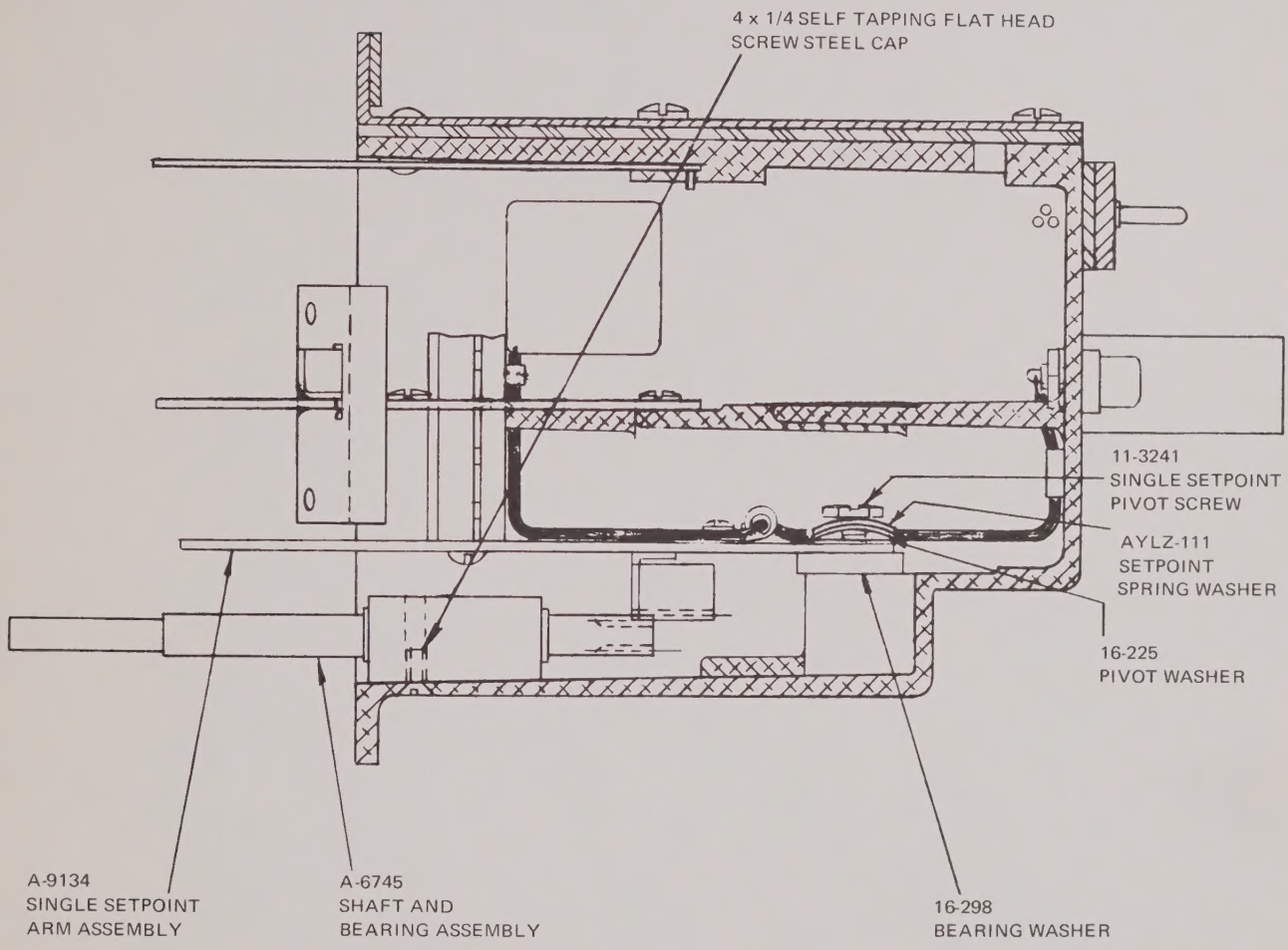


Figure 6-13. Replaceable Parts, Setpoint Mechanism

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